PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office

SEMI-MONTHLY

VOL. XVIII. CHICAGO, OCTOBER 1, 1914 No. 19

Power and Light for Olean

TYPICAL CENTRAL STATION FOR SMALL CITY; STANDARD EQUIPMENT USED THROUGHOUT

IN THE BEAUTIFUL valley of the Allegheny River, not far from its head waters, lies the thriving little city of Olean, N. Y. Several factories of considerable importance are located here and railway facilities are good. Combining the industrial advantages with those which nature has bestowed upon this city, makes it a place attractive to many who love nature, but whose work usually calls them to the large industrial centers.

For a number of years, the electric light and power supplied the citizens of Olean has been furnished by the Olean Electric Light & Power Co. The capacity of its old plant, however, became insufficient to meet the demands of its customers, and during the past 2 yr. a new turbine generating plant has been put into operation and now furnishes all the power sold by the company. The equipment of the plant is standard throughout, but its arrangement and the type of machinery used are typical in most respects of the up-to-date central station in a small city and we present the following description to our readers as that of a type which has taken some time to develop but has proved its superiority and will continue to hold its place for many years to come.

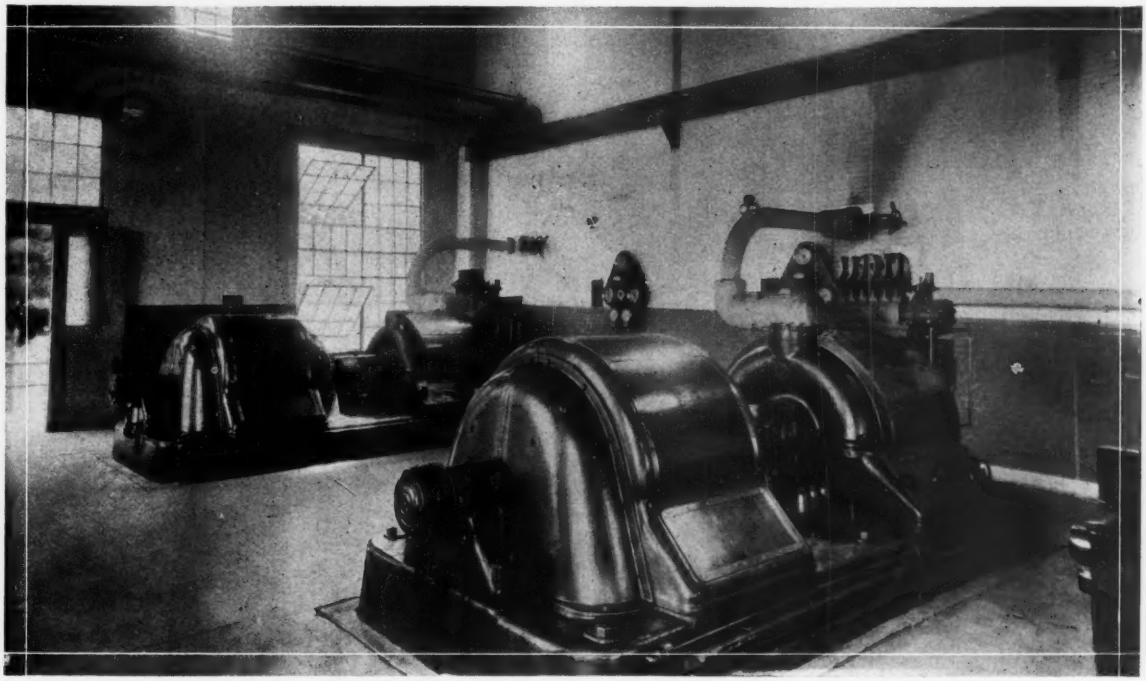


FIG. 1. TURBINES IN OLEAN PLANT

Steam Generating Equipment

For the production of steam, 3 Babcock & Wilcox water-tube boilers have been installed. Each of the first 2 put into operation has a rated capacity of 333 hp., being built up of 160 4-in. tubes 18 ft. long, arranged 16 wide by 10 high, attached through headers to 2 42-in. drums 20 ft. 4 in. long, made of ½-in. steel to withstand a working pressure of 200 lb. A superheater is also provided which adds from 100 to 150 deg. to the temperature of the saturated steam.

These 2 boilers are set in one battery and provided with 3 firing doors to each boiler. The third and newest boiler is in a separate setting which also has 3 firing doors. This boiler, however, is designed for a rating of 500 hp., having 210 4-in. tubes 18 ft. long, arranged 21 wide by 10 high, and 3 36-in. drums 20 ft. 4 in. long

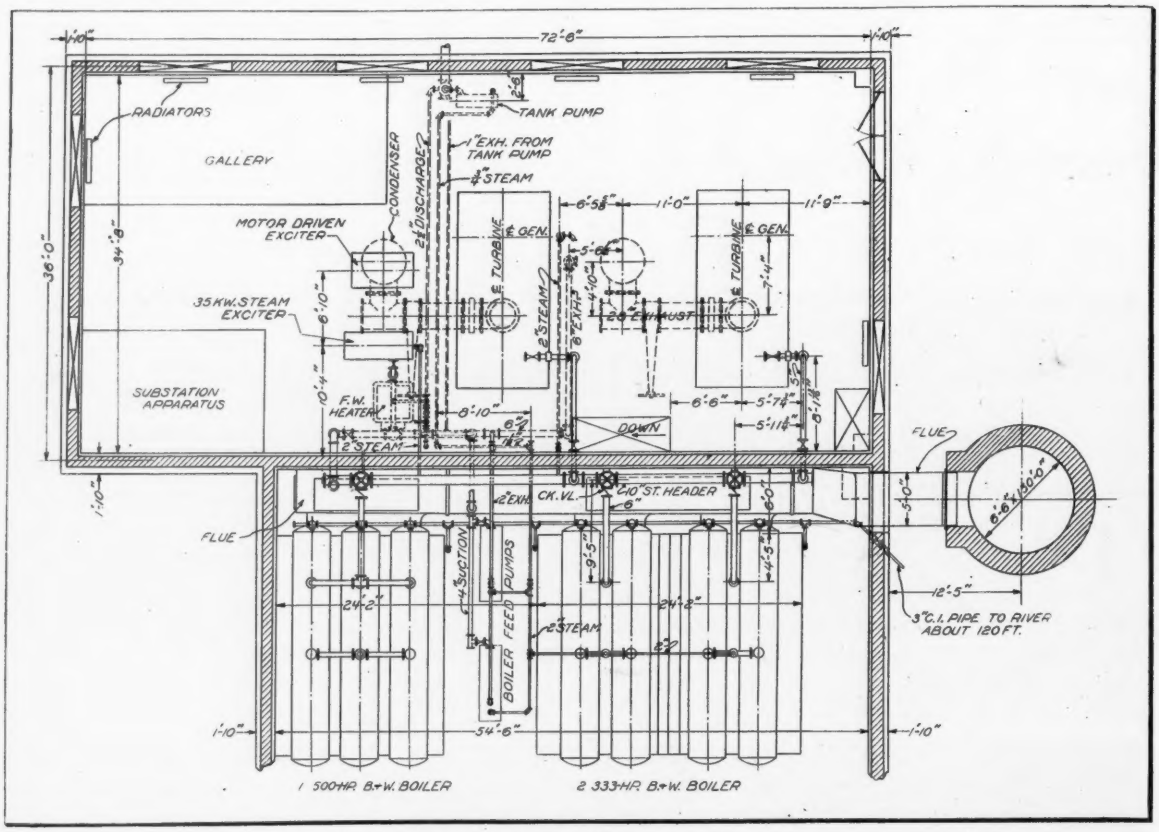


FIG. 2. GENERAL PLAN OF PLANT

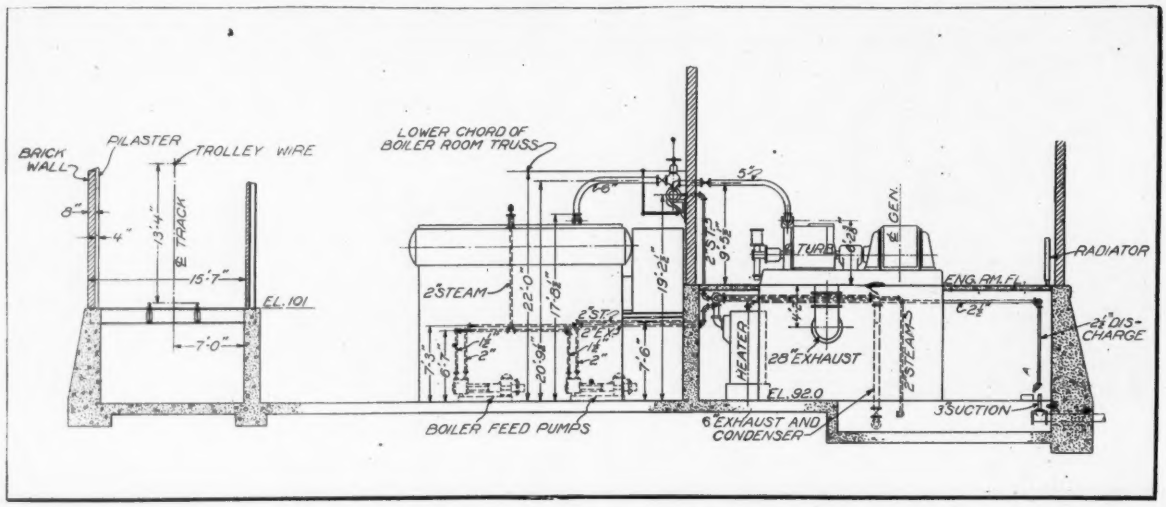


FIG. 3. CROSS SECTION OF PLANT SHOWING PRINCIPAL PIPING

made of 7/16-in. steel to carry a working pressure of 200 lb., the superheater develops 100 to 150 deg.

On each boiler drum and superheater is a 4-in. Consolidated pop safety valve set to blow at 175 lb. There is also a 2½-in. blowoff line to each drum and superheater, these consist of B. & W. angle valves backed by Everlasting blowoff valves, all of which discharge to a header leading direct to the river.

Coal is delivered to the plant in drop bottom cars on a track elevated sufficiently to cover the coal bunker which has its floor level with that of the boiler room. From the bunker the coal is fed by hand to the furnaces.

Ashes are shoveled into wheelbarrows and carried to the hopper of a motor driven Stephens-Adamson bucket elevator which delivers them to a car on the sid-

boilers with a lead to each drum. Water level is maintained by the fireman.

Generating Equipment

Two turbo-generators furnish the current now required by the company. These are General Electric units consisting of horizontal Curtis steam turbines rated at 750 kw. each, run at 1500 r.p.m., steam pressure being 175 lb. The generators are rated at 750 kw. each, with a power factor of 0.8 and furnish 3-phase current at 2300 v., 25 cycles, with windings connected in delta.

Serving each of the turbines is a Le Blanc condenser, the pumps of which are run by Westinghouse horizontal turbines and condensing water is taken direct from the river.

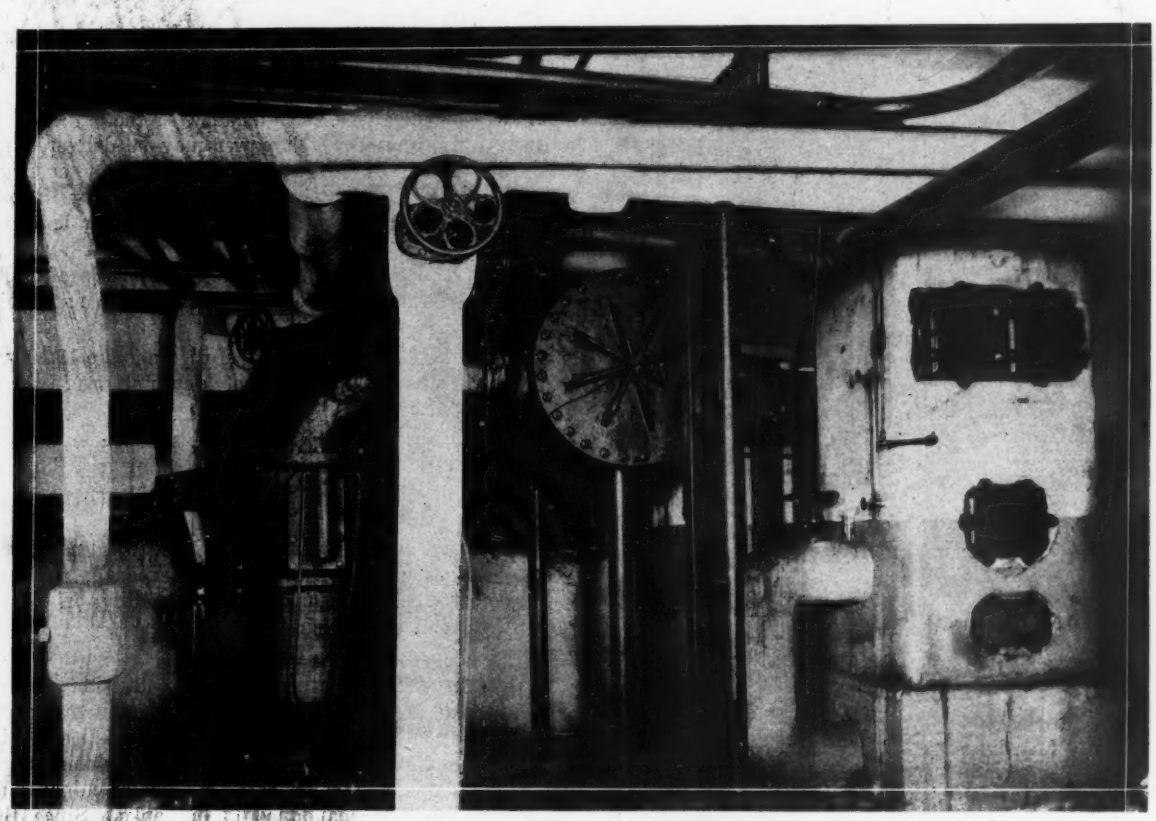


Fig. 4. Condenser and heater in basement under turbine no. 2

ing, thus cars which have delivered coal are loaded with ashes without the necessity of switching.

The gases are conducted by a breeching at the rear of the boilers to the stack which is 150 ft. high with a diameter of 8 ft. Draft is regulated by hand-operated dampers.

Feed water is taken from the discharge pipe of the condenser by a Snow duplex pump and delivered to a 1000-hp. Cochrane heater in the basement below the turbines. Here it is heated by the exhaust steam from the condenser turbines and other auxiliaries to 200 to 210 deg. when it is fed to the boilers by 2 Blake duplex pumps of the plunger type with dimensions 9 by 5¼ by 10 in., located in the passageway between the boiler settings. The feed water header runs along the front of the

Field current for the generators is furnished by 2 exciter sets. Number 1 is a motor-driven General Electric unit consisting of an induction motor of 50-hp. capacity run at 725 r.p.m., on 3-phase current at 2300 v., 25 cycles, direct connected to a 35-kw., d.c. generator developing current at 125 v. Number 2 is a Curtis turbine driven set of the same voltage and capacity, run at 3600 r.p.m.

As an aid to the turbine operators, a gage board is provided for each unit upon each of which are mounted the following instruments: Steam gage, vacuum gage, steam gage showing pressure in first stage, all of which are Ashcroft instruments, a G. E. speed indicator, a barometer, and Bristol recording vacuum and recording steam gages.

Electric Control

Probably the most distinctive feature of this plant is the arrangement of the switching apparatus and means for controlling the outgoing circuits. Figure 5 shows the

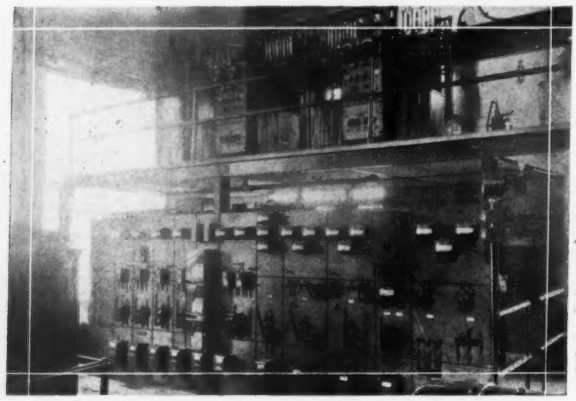


FIG. 5. SWITCHING APPARATUS IN OLEAN PLANT

main switchboard which is located on the floor of the turbine room. Directly above it is the gallery containing the rectifiers.

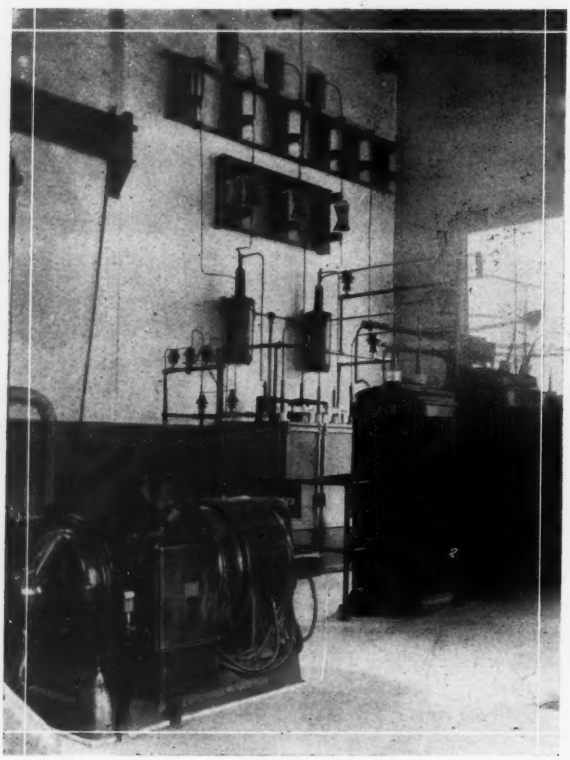


FIG. 6. EXCITER UNIT AND SUBSTATION EQUIPMENT

The switchboard is made up of 12 panels consisting of one to control the exciters, one control panel which supports the Tirrill voltage regulator, 2 generator panels, one for high tension circuit supporting 3 ammeters and remote control switch, one for the arc and station light circuits, one totalizing panel, 4 distributing panels and one blank which will be used to control a motor driven pump at the city's pumping station about a half mile away. On a swinging bracket at the right, are 2 voltmeters and a Lincoln synchronous indicator. Standard General Electric Co. instruments are used except on the totalizing panel upon which are mounted recording wattmeter, recording voltmeter and recording power factor meter, all of Westinghouse make. Plenty of space is allowed at the rear of the board for inspection and repairs.

In the gallery are 2 double, mercury vapor rectifying sets of 200 lights capacity each and 1 single set of 75 lights capacity. These receive current at 2200 volts, 25 cycles and deliver continuous current of 4 amp. to the series arc lamp circuits.

Lightning arresters for the arc light circuits are also located in this gallery. They are of the G. E. aluminum type built for 4600 and 6600 volts.

Arrangements have been made with the interurban railway by means of which power may be delivered to the transmission line of the railway company or may be received by the plant in case either needs assistance. This is accomplished by means of the 3 G. E. transformers shown in Fig. 6. These are single-phase transformers connected in delta with a transformation ratio of 2200 to 19,100 v. Each has a capacity of 150 kw. and is oil cooled.

Near the wall behind the transformers is the 19,100-v. remote control switch, the contacts of which are in separate insulated cells.

The method of taking the high tension wires through the wall is clearly shown in the illustration and the line is protected by electrolytic lightning arresters, also shown.

In laying out the plant, provision was made for future extensions, in case such are needed, without change to the present equipment, by building on to the north as much as is desired.

An interesting feature of the production of anthracite coal in Pennsylvania is the comparatively recent utilization of the smaller sizes of coal—pea, buckwheat, rice and barley grades—most of which is recovered by washing, both from the coal as mined and also from the old abandoned culm banks. Since the first washery was constructed in 1890, the total recovery of useful fuel from the waste heaps or culm banks has amounted to 49,329,376 long tons. These figures include only the coal shipped and do not embrace the washery products sold locally or used at the collieries.

Of the total production of anthracite in 1913, 44,000,000 tons consisted of the domestic sizes and 37,000,000 tons of pea, buckwheat, etc. As a matter of fact, pea coal during the last few years has become an important factor in domestic trade, is now used largely for household furnaces, and probably should be included among the "prepared" sizes. It is no longer sold below the cost of production, like the other smaller sizes.

It's often policy to know a little more than the other fellow thinks you know. In other words, have a reserve fund of information.—Coal Facts.

An Air Lift Engineering Feat

By Frank Richards

I TRUST that many readers will be interested, as I have been, in learning some particulars concerning a recently successfully completed plant which may be characterized as unique in more than one particular. The Morton Salt Co. operates a permanent installation at Ludington, Mich., the original wells and the evaporating, packing and shipping establishment being on the shore of Lake Marquette, which here is about ¾ mi. across and 35 ft. deep. Some valuable wells which it was proposed to bring into operation are situated on the other side of the lake, and it was desired to operate them without constant attendance or the expense of an isolated power plant.

Figure 1, taken from the main plant, shows the site of the wells to be pumped, and Fig. 2 is a view of the main plant from well No. 1 in the previous view. The wells were to be pumped by the air lift, and the brine was to be conveyed from one side of the lake to the

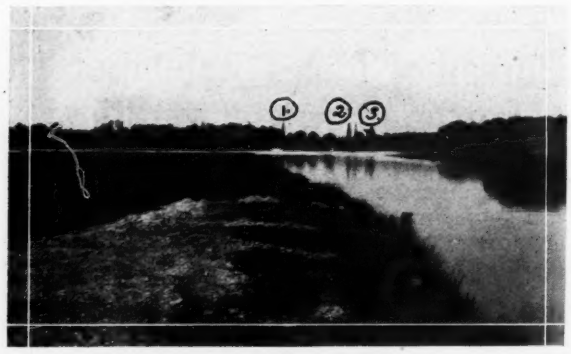


FIG 1. VIEW OF WELLS FROM MAIN PLANT

other, which compelled the laying of both a brine pipe and an air pipe to cross the lake, the former being 6 in. and the latter 4 in. in diameter.

Laying the Pipes

These pipes were put in under the supervision of men furnished by the Union Tank Line Co., and the laying of them illustrates the reliable practice which unlimited experience has developed. It might be thoughtlessly called rough engineering; but complete success, quickly, surely, cheaply secured, is never to be sneered at, especially by those who could not have done so well. The 2 complete lines were put down in less than 20 actual working hours. The line was first laid across the lake on the ice, and then, the ice being cut away, the pipes were lowered to the bottom. The joints of the pipes were the ordinary screw thread couplings and, as there was no preparation of a bed for the pipes to lie in, they were left to accommodate themselves to their bearings as best they could.

Figure 3 shows the pipes just as they emerged from the lake toward the wells, No. 1 being the 6-in. brine pipe and No. 2 the 4-in. air pipe. Attention is especially called to the long, stiff clamp seen on the pipe in this view. This clamp covered the pipe and coupling and effectually protected the threads of the latter from the bending strains which occurred. Air was transmitted through the pipe at a pressure above 225 lb., and surely if this pipe could be made airtight—as it was—there should be no excuse for air leaks anywhere.

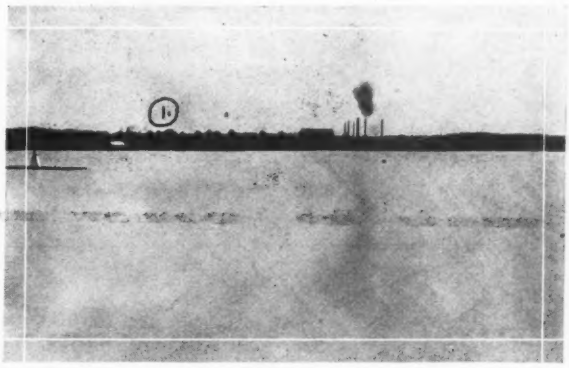


FIG 2. VIEW OF MAIN PLANT FROM DISTANT WELLS

The compressor installed at the power house for serving these wells is shown in Fig. 4. This is an excellent photo of a machine as taken when running at full speed. The arms of the flywheel have entirely disappeared, as has also the crankpin, and only a slight blur outlines the area traversed by the connecting rod. The crank disk shows an overhanging lip which is valuable for catching oil that otherwise would be thrown off

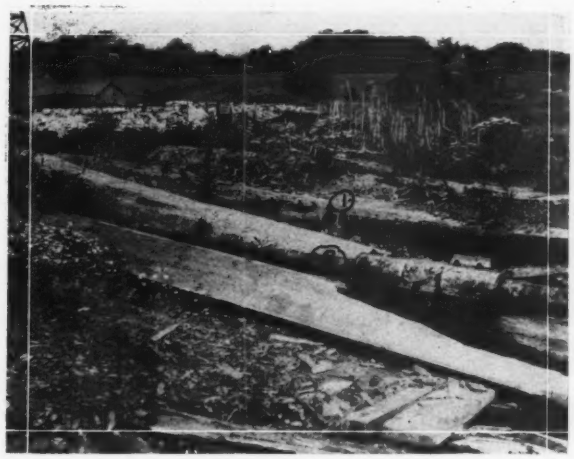


FIG. 3. PIPES LEADING FROM LAKE TO WELLS

by the centrifugal action. The gutter can, of course, be wiped out whenever the compressor is stopped. There are no immediately novel features about the compressor; it is of the straight line type technically designated as Ingersoll-Rand, AA2. The steam cylinder is between the flywheels and the piston inlet, low-pressure air cyl-

inder is at the further end, with the high-pressure air cylinder inside and connected by a large overhead intercooler. The steam cylinder is 24 in. diameter, and the air cylinders are 19½ and 9¼ in., respectively, with a common stroke of 24 in., and a capacity, at 140 r.p.m., of 1100 cu. ft. of free air per min., delivered at a pressure

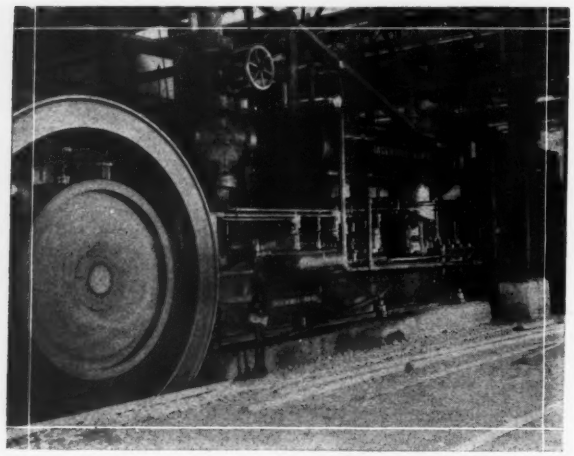


FIG. 4. COMPRESSOR FURNISHING AIR FOR WELLS

as high as 300 lb., which, by the way, is higher than the normal working pressure for a machine of this type.

The Air Lift

Air lift operation in this case is somewhat complicated. The air is delivered to the wells at a pressure of 225 lb. The pipes are carried down to a depth of 700 ft. while the lift is 335 ft. to the booster, which gives a submergence of about 53 per cent and a surplus of pressure in the booster after the delivery of the brine.

FIG. 5. BOOSTER AND AIR, WATER AND BRINE PIPES

This surplus pressure, about 22 lb., is employed to drive the brine through the 6-in. pipe under the lake 4400 ft. and elevate it 48 ft. to the settling basin, from which it is distributed to the exaporators and grainers. Besides doing this work, there is a considerable volume of air remaining at the booster, which is carried down to the lake, where it serves as an air lift to elevate fresh water high enough to flow to well No. 2. It flows down this well by gravity into a common cavity, where it dissolves the salt, forming the brine which is pumped through wells 1 and 3 to the surface.

Referring to Fig. 5, 1 is the booster itself, 2 is the surplus-air pipe for the fresh water service, 3 is the air-and-water delivery pipe from the wells, 4 is the 6-in. pipe for the long run of the brine to the other side of the lake, while 5 and 6 call attention to the mode of supporting the booster to make all the pipes accessible.

Economy of operation was considered in this installation, but the main point was reliability. The air lift in detail is not as simple as above outlined, Harris pumps of special design being employed. The air actually passes down the wells outside of and around the brine line, or, in other words, the discharge pipe is inside the air pipe.

There would have been no economy in using a condenser for the steam, as all the exhaust is used under the evaporating pans.

For the photos and the information here presented, I am indebted to James C. Gillies of the Chicago office of the Ingersoll-Rand Co., of Illinois.

Bureau of Mines' Exhibition at Panama-Pacific Exposition

THE United States Bureau of Mines is planning a comprehensive exhibit at the Panama-Pacific Exposition.

In arranging the exhibit, the bureau has had in mind, not only the value of interesting those engaged in the various mining and metallurgical industries, but also the education of the general public to a better knowledge of the magnitude of these industries and to the efforts which are honestly being made by the miners and mine operators, with the assistance of the Bureau of Mines, looking toward a more safe conduct of mining and a more efficient utilization of the products of the mines after they are won from the earth.

The bureau's exhibit is located in the Palace of Mines and Metallurgy. An automatic duplex projecting machine will continuously show lantern slides illustrative of the activities of the bureau and simultaneously give descriptions of the lantern slides.

Nearby will be shown the layout of a model hospital, including a receiving room, ward room and operating room, fully equipped for demonstrations by the United States Marine Hospital Service; also a model of a change and wash house, another welfare feature which is being installed at modern mining and metallurgical operations. A plan of an ideal mining town will be shown.

First-aid demonstrations will be given frequently. An air of reality will be lent to the demonstration by the removal of apparently injured men from the exhibition mine beneath the building by helmet and rescue crews.

A complete display of rescue apparatus and safety lamps will be given in a glass smoke-room. Tests of safety lamps will be made, showing their tendency, under unfavorable conditions, to ignite explosive gas,

and also showing methods of testing for explosive gas by means of their caps. An exhibit of the physical and chemical characteristics and constituents of explosives is being arranged.

Visitors going through the exhibition mines will regain the surface through the radium booth in which actual radium emanations will be shown. Surrounding this radium booth, there will be complete exhibits of the various radium ores and of radium products. The metallurgy of various products will be shown by a comprehensive exhibit.

The opportunity for increased efficiency in the use of fuels will be demonstrated by a device showing the proportionate amounts of fuels which go to make up the various loses incident to consumption in comparison with that which ultimately goes to useful purposes. Typical analyses of coal from the various fields will be shown by models and samples, as will also the yield of coke and byproducts obtained by various coking processes. It is expected to show smoke-preventing and smoke-producing methods of stoking by means of an ingenious motion-picture device.

An officer of the bureau will give his whole attention to visitors. Copies of the bureau's publications will be available for free distribution to visitors who may be particularly interested.

This exhibit, in connection with the exhibition mine immediately beneath the bureau's space, should be interesting and instructive to those engaged in the mining industry and to the general public.

Speed Governing for Unusual Requirements

By Sterling H. Bunnell

STANDARD engines with standard governors have become so similar in performance that almost any engine builder would be willing to substitute the specifications of another for his own, if so requested. For direct-connected electric generating service, for instance, all engines are expected to regulate within 1 or 2 per cent, and to hold voltage closely under instantaneous release of load. This duty is performed by various types of governors, having characteristics quite different one from the other. To reach the common standards of performance, slow types of governor must be designed for the quickest action possible to them; supersensitive governors must be provided with means for holding them in check; and so with each of the various forms.

When unusual service is to be performed, the standardized governors may not suit at all. The very characteristics which have been suppressed, may be the ones which should be developed to aid in special conditions. If it is necessary to change the speed when running, or to adjust the speed through a very wide range, the service may be impossible to some forms of governor, though quite within the reach of other types. In fact, bearing in mind that standard engines of different makes are provided with different governors, it is evident that the selection of an engine for peculiar service conditions should often commence with the governor.

An engine with fixed cutoff has every probability of taking more steam than necessary for the load, and is suitable for use only where fuel costs nothing, or for intermittent heavy work, such as hoisting, where great pulling power is wanted. In consequence, the automatic cutoff engine is the natural first choice for all service where economy is desired. But the automatic cutoff is always associated with the shaft governor, which must run at constant speed to be operative. Whenever an automatic cutoff engine is to be run at any of several speeds, it will take, regardless of the load, all the steam its latest possible cutoff will permit, under all speeds below the exact speed at which the shaft-governor operates. In glass polishing, for instance, the engine is run under slow speed for many minutes together, and brought up, by 2 or more stages, to full speed for a fraction of the whole period of grinding the lot of glass. With automatic cutoff, an engine under such conditions would use as much steam as a plain throttling engine—probably more. Whenever a wide range of speed is required, a shaft-governed engine is unsuitable.

For such variable speed service, as in paper mills, asphalt works, glass factories and other operations, choice should be made among standard makes of engines of types which can be readily fitted with hand-adjusting cutoff and throttling governor. According to size and exactness of speed requirements, engines may be of any single-valve type, with valve shifted by a wrench-adjustable eccentric, or an arc-shaped valve-arm with hand-adjustable valve pin, a link motion, or Porter-Allen eccentric; or the engine may be of the 2-valve type, with main and sliding cutoff valves adjustable by screw and handwheel. The speed-regulating should be done by a substantial, well-fitted throttling governor driven by gearing to prevent slip. The governor should be provided with spring or weight speed adjustment to cover about twice the range between the gear-changes.

In operation, such an engine will be started from rest with the valve set for late cutoff, and brought close to speed by adjusting the throttling governor. The cutoff will then be shortened until the governor is throttling but little, and left at that point. If the load varies irregularly, the cutoff must be left long enough to carry the peaks of the load. If the engine is not provided with adjustment operative when running, but with a plain adjustable eccentric only, then the cutoff can only be set by trial to give power enough for the maximum load, and the light loads taken care of by throttling. The question of providing sufficient flywheel weight, for a double-crank engine, to give steadiness at the lowest speed, is for the engine designer to determine.

With Corliss releasing-gear, a variable-speed governor can be applied directly to the valve-motion to control the cutoff, instead of throttling the steam supply. But the limitation in speeds suitable for release-gear may not be enough for the requirements. Positive-acting slide valves in a 2-crank engine will afford speeds from 35 or 40 to 200 r.p.m., while release gear can

hardly be run through a greater range than 60 to 120. The action of the dashpots becomes uncertain at low speed, and the wear and noise of the valve-gear is objectionable at high speed.

With speed variation limited to not more than 2 to 1, the regular Corliss valve gear makes a good equipment. With uniform load at any given speed, however, the hand-adjusted cutoff and throttling governor gives as good economy as can be obtained with automatic cutoff regulation under the same conditions.

Where engines must carry widely varying loads, shaft governors with automatic cutoff are essential, and can be arranged to give a certain degree of speed variation if required. In operating alternating-current generators in parallel, a speed adjustment of 5 per cent is desirable. The most direct way of making the adjustment is through gearing from a stationary point to a nut on the tension screw of the governor spring. Another possible way is by electrical connections through collecting rings on the engine shaft to a small motor carried in the governor wheel, and arranged to revolve the nut on the spring tension screw. With the inertia governor, still another method is possible, which is to check the movement of the valve rod by a dashpot and adjustable bypass valve. Any of these devices will make it possible to bring an engine to the exact speed of another, preliminary to throwing the generator into the line. But to obtain proportionate division of the load between engines running in parallel, the speed characteristics of the governors must be alike through their whole range of action. If one is quicker in action than the other, its engine will dig into an increasing load and take more than its share, probably setting up a hunting motion. The same engine will run away from a decreasing load, leaving too much on the other engine. If one governor has a drop of 2 per cent from no load to full load, and the other drops only 1 per cent, the latter will take more than its share of a heavy load.

The compounding of the generator combines with the coefficient of regulation of the governor in determining whether 2 engines in parallel will divide the load properly. The unit with higher compounding will take too much of a heavy load, if its speed is maintained; but the governor may be adjusted so that a greater drop in speed will occur at this load, and so reduce the load to the proper proportion of the whole. As a compound-wound generator increases its voltage under increase of load, some drop in speed can be permitted. Extreme accuracy in regulation is, therefore, quite unnecessary, and steadiness may well be gained by adjusting the governor for a reasonable drop of 2 to 3 per cent. With alternating-current generators in parallel, a drop in speed as great as 5 per cent from no load to full load helps much toward good load division and easy synchronous running.

Whatever the conditions required of an engine, they can in general be met by the standard practice of one or more engine builders; with slight alterations if any. By deciding first upon the type of governor best suited to the requirements, and then investigating the field to ascertain whether any standard engines embody the desired construction, it is often possible to obtain an engine equipment as perfectly adapted to the work as if specially designed for the purpose, and at the moderate cost of a standard machine.

Blowoffs for Boilers

FRONT END CONNECTION TO REMOVE SCALE ACCUMULATIONS; SLEEVE COVERING TO PROTECT FROM HEAT. BY RECEIVER

ONE naturally looks for the blowoff to be connected to the lowest point of the boiler at the back end to enable the boiler to be emptied completely when necessary, as boilers are set with the rear end an inch or so lower than the front, to make sure that the rear of the tubes, also the fusible plug, are covered with water when water is seen in a properly connected water column and to increase the length of time before the rear is level with the front end caused by the gradual settling of the front and gradual raising of the rear, the contents readily drain.

When water containing scale-forming matter is used for feed, the blowoff pipe sometimes becomes clogged. For years, we taught our men that one of the chief uses of the blowoff was to remove scale; yet with bad water or that containing silt in considerable quantity, and when compounds are active in removing old scale, the amount removed through the blowoff, even when blowing down several times daily, has been disappointing to many. The why of this is as follows:

When a tubular boiler is at work, the circulation is up the center, down the sides from back to front, and the foreign matter that is in solution is carried along with the circulation so that little can be removed by opening the blowoff. When heavy scale is encountered, more may be removed since it will lie lower in the boiler.

To obtain the best results in the removal of scale, the blowoff should be opened daily in the morning before breaking up the fires. Then scale that has settled near the blowoff may be removed by opening the blowoff, but it is only a small area from which the scale is drawn.

Some time ago the writer saw 2 old boilers cleaned, in which one had the blowoff connected in the usual approved manner, while the other, having a blowoff connection of like description, had settled at the front so that on opening up the boiler some 2½ in. of water remained on the shell. A 2-in. pipe was tapped into the front head between the bottom row of tubes and shell and was used to remove practically all the water referred to. All blowoff pipes from the 2 boilers discharged where they could be seen, and much more sediment came from the front pipe under normal conditions and especially in the morning when these blowoffs were opened before breaking up the fires.

The reason may be deduced that, when the fire is banked, the temperature in the fire box drops and the highest temperature through the setting as a whole is

from the bridge wall to the back end; hence, the direction of circulation is reversed and the scale settling during the night is deposited in the vicinity of the bridge wall, and because of the inability of the usual blowoff to remove it, collects so that when the boiler is working, the intense heat makes a bag because the scale prevents the water coming in contact with the plate. That this action is about what occurs, is shown from the fact that a bag is usually located over or near the first girth seam and occurs after starting up the boilers. With the open end pipe connected to the front head, as in Fig. 1, the greater part of such bridge wall accumulation was removed.

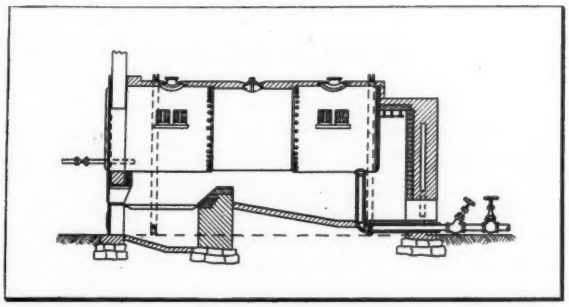


FIG. 1. BACK AND FRONT END BLOWOFFS WITH PROTECTING SLEEVE AND UNDERGROUND DISCHARGE

Having a water for feed that at certain periods contained great quantities of silt, I tapped the front head of one boiler as in Fig. 2, and ran a 2-in. pipe with elbow and funnel as shown, so located that the opening into the funnel was about ¾ in. from the shell. The valve on this was opened with the other blowoffs in the 12-boiler battery, and when opened up to wash out, this boiler showed clean, while the other 11 had quantities of mud. The others were piped accordingly and now, after 6 months use, are free from mud. While, before the change, 4 boilers were washed out each week, now

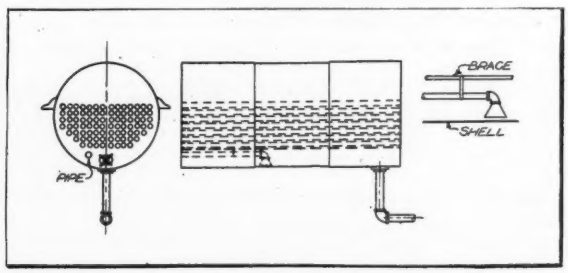


FIG. 2. FUNNEL END TO REMOVE SEDIMENT ABOVE BRIDGE WALL

they are run 8 weeks between washings with complete success, and it is proposed to run 12 weeks now that confidence in the method has been established.

In some cases, to protect from the direct heat of the fire, a fire brick wall in the shape of a V with the opening toward the rear is used; but the better method is to make a pipe sleeve and encase the blowoff pipe, running the pipe down to the bottom of the combustion chamber, then in a trench which is covered with bricks without bend through the brick wall to the blowoff valves, as in Fig. 1. A suitable sleeve should surround the pipe where it passes through the wall, to allow of a circulation of air which will greatly lengthen the life of the sleeve. Care must be observed that at no time does the blowoff pipe bind in the setting because this condition throws heavy strains on this pipe and has been the cause of many accidents.

As usually connected in Fig. 1, the blowoff pipe is a dead end, but to insure a positive circulation, it is often connected as in Fig. 3. Several makes of valve on the market that are satisfactory for blowoff use, have the renewable seat and disc feature and are so

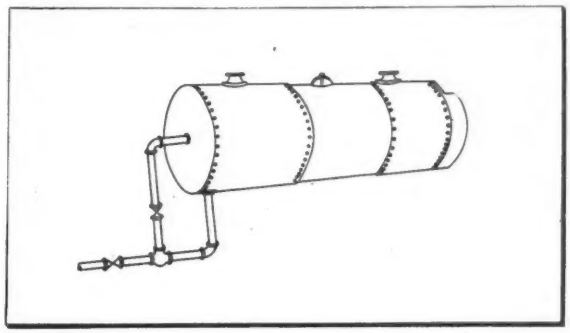


FIG. 3. CONNECTION FOR INSURING CIRCULATION IN BLOWOFF PIPE

made that they can be packed under pressure. Two valves should always be provided on each blowoff, then should anything, as a piece of scale under the disc, prevent the closing of one, the other may be shut and the boiler continued in use.

Blowoff valves should always be of the straight-way pattern, as the pocket formed in a globe valve is favorable to the gathering of scale.

Slide Valve Setting with a "Dummy"

SIMPLE METHOD TO TEACH PRINCIPLE OF SLIDE VALVE OPERATION. BY CARLETON A. READ

DURING a number of years of experience with students at the Worcester Polytechnic Institute and with operating engineers, the writer has found that, although there are many men who can tell about the lead and cutoff or the other events of the stroke of an engine that are controlled by the outside edges of a slide valve, there are comparatively few who have a clear idea of what is taking place on the inside of the valve and what effect certain changes have on compression and release. Of course, marks can be made on the sides of the valve and valve seat just as is done on the ends of a Corliss valve; but even this method does not seem to give all that might be desired, especially in the case of the double ported or Sweet valve with a cover plate.

In a laboratory, valves with one side cut away may be provided; but a block of wood, called by the students a "dummy," makes a cheap and efficient substitute. If one is just learning to set a valve, it might be advisable to mark carefully the position of the regular valve on

the spindle, so that there may be no trouble in getting it back in order to have the engine ready to run at starting time. After this has been done, replace the valve with a wooden block having marks representing the in-

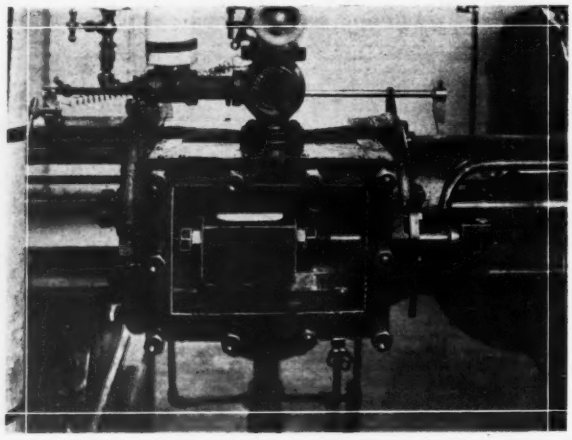


FIG. 1. APPLICATION OF WOODEN DUMMY TO A PLAIN SLIDE VALVE ENGINE

side and outside edges of the valve. In the case of a Sweet valve make not only a block for the valve, but fit a board, outside of it, marked to correspond with the openings on the under side of the cover plate. What

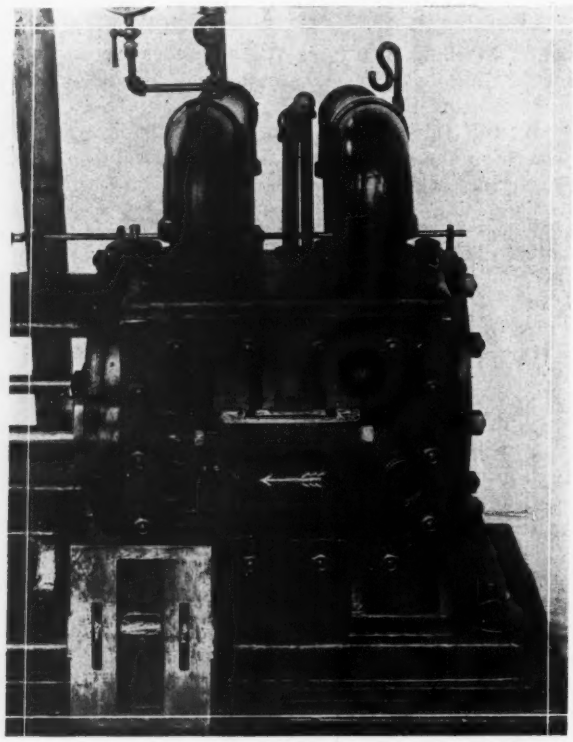


FIG. 2. DUMMY USED ON DRY VACUUM PUMP

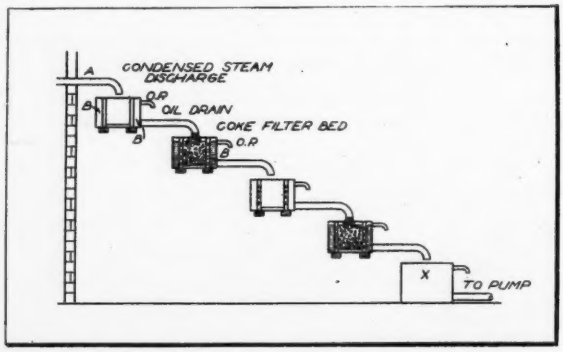
is taking place under the valve or cover plate can now be seen as well as what is taking place on the outside and if the marks are changed from time to time, one can see just what effect changing the laps has on the events of the stroke. Another place where this scheme has worked well is in connection with the study of the slide valve, with a flash port, on the air end of a rotative dry vacuum pump, which seems especially difficult to understand.

With a "dummy," any engineer who is allowed to remove his steam chest cover, can, in a few hours, get such a hold of the principles of the valve that the questions of an examiner on this subject will have no terrors for him and obtained in a manner far more satisfactory than that of trying to remember what someone has told him.

Separation of Oil from Condensed Steam

By W. T. Wardale

A FILTER which has been found successful in removing nearly all the oil from condensed steam, consists of a series of 5 tanks, each having a coke filter bed in the center, through which the condensate passes, leaving this filter bed through a perforated casing, and being drawn from the bottom of the tank outside the casing. At the top of the tank is an overflow pipe, which removes such oil and impurities as rise to the top. By the successive filtering, the condensate is increasingly purified, and leaves the fifth tank in reasonably good shape. It is then treated with a boiler compound, specially designed to remove the remaining oil and other impurities, and the use of the condensate so treated has continued for a number of years, without causing any difficulty, in a plant where the boilers are run at high pressure and heavy overload.



ARRANGEMENT OF FILTERS IN STEPS

It is also recommended that the steam, before passing to the condenser, should be sent through a separator having large baffle plate surface so arranged that the removed oil is conveyed at once to the bottom of the separator, and does not come in contact with the passing steam.

In using condensate, care should be taken to avoid the return of any emulsified oil to the boiler with the water, as this oil will accumulate, even if there be only a grain or 2 per thousand gallons, and will float on the surface of the water, thus coating the tubes and shell when the boiler is blown down, or, if there are magnesia salts in the feed water, forming a particularly bad scale on the boiler plates.—The Power User.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Locating Direct-Current Armature Faults

SHORT DESCRIPTION OF HIGH VOLTAGE, INDUCING MAGNET AND RECEIVER, AND VIBRATOR AND RECEIVER METHODS. BY GORDON FOX

THE more common faults with direct-current armatures are: short circuits, open circuits and grounds and, sometimes, in a new armature or one just rewound, a reversed coil or wrong connection. There are many ways of locating these faults, which at times are simple matters and at others a more careful test may be necessary. Several methods have been suggested from time to time, many of them based upon the use of a galvanometer; but since few operating plants possess

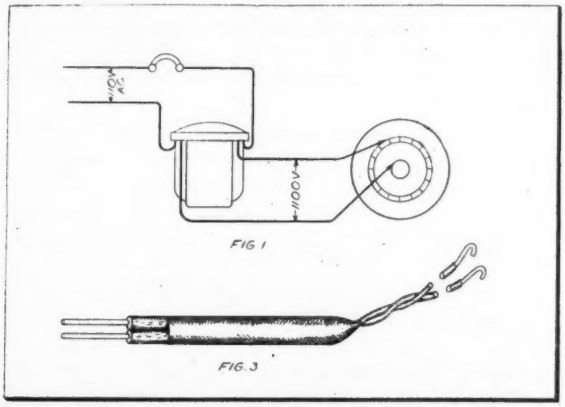


FIG. 1. HIGH VOLTAGE METHOD OF TESTING ARMATURE GROUNDS FIG. 3. EXPLORING LEADS

galvanometers, such methods are not often feasible. This article outlines the methods commonly used for factory testing which can be well adapted for general use.

Short circuits and open circuits in direct-current armatures in operation usually show symptoms indicating the nature of the trouble. If a coil in a direct-current armature be short-circuited, a heavy local current will flow through the coil or that portion of it affected, and will cause the coil to heat up and perhaps smoke. If the machine be stopped and the butts of all the coils be felt, the hotter coils may generally be located with ease and the source of trouble thus localized. If the armature has a lap winding with a short between commutator segments, but one coil will be heated; while with a wave winding, several coils may be heated and further tests may be required to determine the exact location of the fault.

Open circuit occurring in a direct-current armature usually causes a peculiar type of sparking. Instead of the ordinary pin sparks under the brushes, fine bluish green rings of fire encircle the commutator and the voltage between commutator bars connected to the faulty coil is greater than normal so that the current tends to arc across the mica segments. If the machine be shut down after operating a short time with an "open," it will be found that some of the mica has become pitted, in the case of a 4-pole machine the pitted segments being diametrically opposite each other, while in a 6-pole machine there will be 3 pitted segments 120 deg. apart, this pitting indicating the location of the faulty coil to which they are connected.

USING HIGH VOLTAGE ALTERNATING CURRENT

A GROUND in an armature may not affect operation at all unless the feeder circuit is grounded, and the location of such a ground or even a short circuit may sometimes be detected by the burnt insulation odor, easily recognizable. If a ground is only partial, it may be possible to locate it by the high-potential or "hypot" method. For this purpose, about 1000 volts alternating

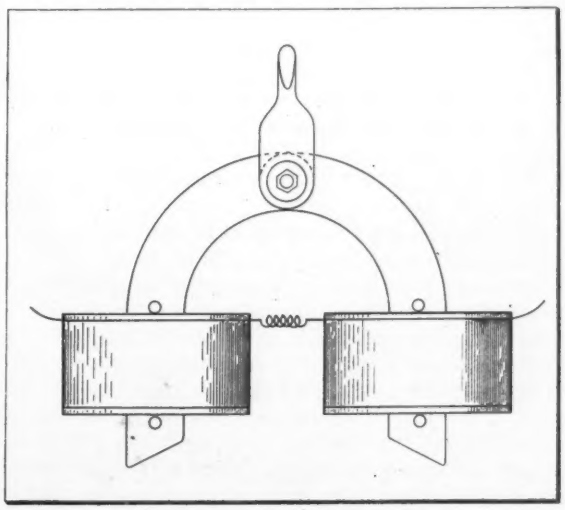


FIG. 2. INDUCING MAGNET FOR DETERMINING ARMATURE FAULTS

current is used, this being secured from a step-up transformer provided with a fuse or circuit breaker in its primary. One terminal of the 1000-volt line is connected to ground, the other terminal to the commutator, and the current flowing will likely break down the poor insulation at a partial ground, causing an arc to occur which may be visible, or smoke from it may show its where-

abouts. A dead ground cannot be located by this method. Figure 1 shows the connection for and application of the high-potential method of testing for grounds.

Inducing Magnet Method

One common factory method of testing direct-current armatures for faults will be described next. A special alternating-current magnet is made up in horseshoe shape from sheet-iron laminations, the 2 legs being made separate, and the laminations interleaved and hinged as shown in Fig. 2, to permit adjustment for various sizes of armatures. Upon this laminated core is wound a magnetizing coil mounted as shown, and connected to a 110-volt or 220-volt alternating-current circuit. The armature is mounted on horses or supported in some manner so that it may be easily rotated, while the testing magnet is so adjusted that its 2 poles correspond in span to the throw of a coil. An air gap of about ¼ in. is left between the armature and test magnet, the adjustment of which can be most easily made if the magnet is hung from a chain block or rope fall.

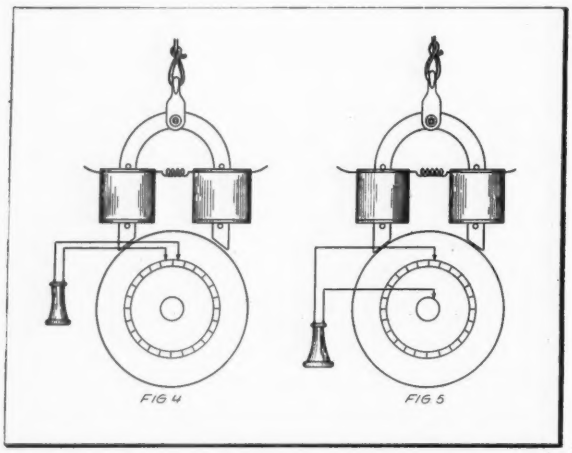


FIG. 4. RECEIVER METHODS OF DETERMINING SHORT CIRCUITS

FIG. 5. RECEIVER METHOD OF DETERMINING GROUNDS

The alternating flux set up by the test magnet causes a voltage to be induced in the coils of the armature and as a consequence there exists a potential difference between the commutator bars connected to these coils. If now, a piece of metal such as a small flat strip be lightly laid across the commutator segments connected to the coils under the test magnet and the armature be slowly turned, keeping the metal strip stationary, as the local circuits closed by the test strip are broken, there will occur quite evident sparking. There will be no potential difference between the segments to which a short-circuited coil is connected, hence there will be no arcing when the test strip bridges these bars. In the case of an open circuit or reversed coil, the sparking will also be absent, so that the location of such a fault may be determined but its nature may not be shown.

To determine a short circuit, the iron test strip may be bridged across armature teeth. The comparatively heavy current flowing in a short-circuited coil will cause the teeth adjacent to it to be heavily magnetized locally. The bridge piece will detect this local magnetization, thus betraying the source and nature of the trouble. Also, a short-circuited coil will quickly heat up ahead of its neighbors due to the heavy localized current flowing in it.

A refinement of this method a little slower in its application, but more definite and certain in its results, makes use of a telephone receiver to detect the faults. The armature is mounted as before with the test magnet adjacent to it. The telephone receiver is provided with a pair of "exploring leads" such as shown in Fig. 3. These are made by connecting 2 pieces of No. 6 rubber covered wire to a length of lamp cord, taping the wires side by side and bending the exposed ends so that they will span from one commutator segment to another.

The exploring leads are bridged across the 2 bars corresponding to the coil under the test magnet, or thereabouts. Due to the induced voltage in the armature coil, there is a slight potential difference between these segments, as before stated; consequently, when the receiver circuit is bridged across the bars an alternating current will flow through the receiver, and its diaphragm will be caused to vibrate, so that a hum will be heard. If the commutator bars or the armature coils are short-circuited there will be no potential difference between segments, consequently no humming. In case of a partial short in the coil, that is, a short circuit between turns cutting out part of the coil, the intensity of the hum will be decreased in proportion to the number of shorted turns.

If the armature is open-circuited, there will be a rather large potential difference between commutator bars connected to the defective coil; consequently, when the exploring leads bridge these bars, a rather heavy current will flow through the receiver and a loud click will result.

In the case of a reversed coil, 3 or 4 adjacent bars will test silent and it will be necessary to lift the tops and trace out the individual coils to determine the exact location of the fault.

In all the above tests, the characteristic signal may occur at 2 or more symmetrically located points according to the winding. In most cases the exact location of the fault is thus detected but in some instances it may be necessary to test among 2 or 3 coils to find which is defective.

To locate a ground by this method, the exploring leads are discarded and the receiver cord is provided with separated ends. One terminal is connected to the armature shaft or stacking; the other terminal is held on the commutator while the armature is slowly rotated. The proper location of this terminal on the commutator is about the same as that of the exploring leads in the previously described tests. At a point where there is a ground, there is obviously no potential difference between the coil and core; hence, at this point the receiver circuit connected from commutator to core will carry no current and will test silent. At other points the humming will occur, the intensity being least at points near the defective coil and increasing as the intervening distance increases. This test may be ineffective for a partial ground, but this latter type of ground can usually be detected by the "hypot" method previously mentioned.

Sometimes a so-called "flying ground," "flying short" or "flying open" will occur in an armature. This means that centrifugal forces or expansion through heat or a combination of the 2 will cause the coils to move slightly at some point so that bare spots normally separated will be caused to make contact. In a "flying open" a break in a wire may be normally closed through pressure of the insulation or by surrounding coils but, due to forces acting because of rotation, the circuit is temporarily opened. These types of faults are difficult to locate since an armature may test perfect when stationary and still show the presence of a fault when running.

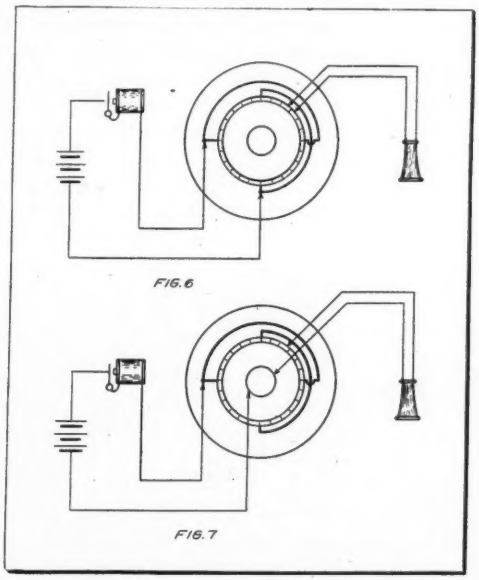


FIG. 6. VIBRATOR METHOD OF DETECTING SHORT CIRCUITS
FIG. 7. VIBRATOR METHOD OF DETECTING GROUNDS

Usually the only thing to be done is to run the machine until the fault will burn and aggravate itself so that it can be detected by the usual means when at a standstill.

Vibrator and Receiver Method

In the field it is not feasible to transport a device as cumbersome as the above and a method utilizing but the simplest of equipment yet comparable in reliability for general work is therefore here described. This method as before utilizes a telephone receiver for detecting faults but, instead of inducing an alternating voltage in the armature by means of the test magnet, an interrupted current from a battery and buzzer is used. The outfit is set up as in Fig. 6, the armature not being removed from the bearings to make this test. Battery and buzzer are connected in series, the 2 leads from them being placed under adjacent brushes of opposite polarity or connected to the armature leads of the machine. The exploring leads from the telephone receiver are then held about midway between brushes spanning from one segment to the next as before. All machine switches are of course open and no current other than that from the test battery is on.

It will be seen that this pulsating current flowing from brush to brush through the armature will cause a voltage drop through each coil, hence there will be a slight potential difference between segments. The receiver bridged across 2 segments will carry a little of the pulsating current and a humming sound in the receiver will result, provided the coil is perfect. In case of a short there will be no potential difference across the defective coil so that the receiver will test silent, while in case of an open there will be full battery voltage across the break and a loud click or hum will be the signal. Partial shorts between turns are difficult to detect by this means, a slight decrease in intensity of the hum being their indication.

To locate a ground, the outfit is connected as in Fig. 7. The test and indication are the same as for the inductive magnet method, a ground being shown by the silent test while adjacent bars show reduced intensity of the hum.

The battery and buzzer method requires the least equipment hence is often most handy to apply. It is more delicate and is more difficult to apply than the inducing magnet method.

Power Costs in Central Stations

Cost Reports; Comparison of Costs and Their Causes

BELOW may be found 2 monthly generating cost reports of 3 typical central power stations located in the central states and for convenience designated in this report by letters A, B and C. These 2 reports cover the months of June and October, 1913, and consequently include the light load period and a comparatively heavy load month respectively:

General Equipment of Plants

Before discussing any of the figures embodied in this report it is no more than proper that at least a general description of the apparatus contained in these stations be given.

Station A, with a capacity of 5000 hp. in boilers and 5000 hp. in engines, has as prime movers nothing but reciprocating engines, some of which are belted and others direct-connected to direct-current and alternating-current generators. The 10 boilers in this plant are fired with Illinois screenings, and the water used is obtained from wells and the local water works.

Station lettered B, located in the State of Indiana, contains water-tube boilers and condensing turbines; like station A, it obtains its water supply from wells and local city service and uses almost exclusively screenings for fuel.

Station C, with a total capacity of 14,000 kw. in condensing and noncondensing reciprocating engines and turbines, has a capacity of 5400 hp. of water-tube boilers supplied with water from the Illinois River and private wells. As in the case of the other plants, this station also uses screenings, fired by stokers.

Comparison of Load Increase and Factors Affected

From the reports, it is noted that during the month of June, station A generated a total of 1,061,000 kw.-hr.; station B, 1,210,750 kw.-hr., and station C, 1,404,605 kw.-hr.; while, during October, these same plants turned out 1,356,610, 1,215,360 and 1,704,596 kw.-hr. respectively, showing an increase for A of 28 per cent,

for B, 0.3 per cent and for C, 21 per cent, with a corresponding increase in fuel consumption of 10 per cent, 16 per cent and 23 per cent respectively. From these figures, it is seen that the per cent increase in fuel consumption is out of proportion to the per cent increase in load. This can readily be accounted for when it is stated that all of these plants supply steam for heating purposes, record of which is not embodied herein, and without which it is hardly fair to make much more than a passing remark.

GENERATING COST REPORT — June, 1913

	A	B	C
Kw.-hr. generated	1,061,000	1,210,750	1,404,605
Tons of coal	2,775	2,437.37	3,981.40
Tons of ash	555	322.10	603
Lb. water evaporated	40,600,000	35,359,500	58,100,000
Lb. water evaporated per lb. coal	7.32	7.25	7.5
Lb. coal per kw.-hr.	5.23	4.03	5.55
Lb. water per kw.-hr.		29.20	41.6
Gal. engine oil per 1,000 kw.-hr.	3.62	0.59	1.94
Gal. cyl. oil per 10,000 kw.-hr.	1.74	0.39	1.22

Total cost and cost per Kw-hr. in cents

	A	Kw-hr.	B	Kw-hr.	C	Kw-hr.
Superintendence	122.12	0.014	250.10	0.020	246.47	0.018
Repairs						
Dynamos and appliances	171.33	0.019	10.84	0.001	12.94	0.001
Engines						
Boilers	1,017.48	0.115	299.81	0.024	.....	.....
Pumps pipes fittings & misc.	8.80	0.001	22.15	0.002	1332.34	0.094
Operating boilers	880.92	0.100	392.13	0.033	794.96	0.057
Operating engines and dynamos	693.66	0.079	390.00	0.032	689.79	0.049
Supplies	5.47	.....	44.80	0.004	101.10	0.007
Water	482.21	0.055	99.75	0.008	.....	.....
Lubricants & waste	220.12	0.025	42.50	0.004	95.74	0.007
Miscellaneous expense	291.24	0.033	60.08	0.005	177.68	0.013
Total, except fuel	3893.65	0.441	1612.16	0.133	3451.02	0.246
Coal	2835.75	0.298	2177.44	0.180	4906.44	0.349
Coal, labor, car to Boiler room	198.62	0.022	114.62	0.009	105.48	0.008
Total cost	6728.02	0.761	3904.22	0.322	8462.94	0.603
Average cost of coal per ton on floor of boiler room	1.0214	.....	0.94	.....	1.344	.....

POWER STATION REPORT — October 1913

	A	B	C
Kw.-hr. generated	1,356,610	1,215,360	1,704,596
Tons of coal	3,052.4	2,838.5	4,900.72
Tons of ash	610.5	456.53	1,080
Lb. water evaporated	39,681,000	35,625,500	64,484,866
Lb. water evaporated per lb. coal	6.5	6.28	6.58
Lb. coal per kw.-hr.	4.5	4.67	5.75
Lb. water per kw.-hr.		29.31	37.83
Gal. engine oil per 10,000 kw.-hr.	1.24	.41	.95
Gal. cylinder oil per 10,000 kw.-hr.	7.07	.41	.40

Total cost and cost per Kw-hr. in cents

	A	Per Kw-hr.	B	Per Kw-hr.	C	Per Kw-hr
Superintendence	121.67	.010	243.74	.020	201.14	.012
Repairs—						
Dynamos and appliances	245.18	.020	21.93	.002	469.43	.028
Engines	.....	....	.....	....	66.78	.004
Boilers	559.11	.046	484.51	.040	833.61	.049
Pumps, pipes, fittings and misc.	16.32	.001	9.00	.001	595.97	.025
Operating boilers	608.64	.050	396.15	.033	843.68	.049
Operating engines and dynamos	718.88	.059	390.00	.032	673.29	.039
Supplies	41.65	.004	16.50	.001	116.25	.007
Water	354.97	.029	98.16	.008	.....	....
Lubricants and waste	228.82	.019	37.50	.003	150.66	.009
Miscellaneous expense	78.39	.007	41.89	.003	246.18	.014
Total, except fuel	2973.63	.245	1739.38	.143	4196.99	.246
Coal	2899.91	.239	2469.50	.203	6150.62	.361
Coal labor, car to boiler room	187.60	.015	135.60	.011	183.20	.011
Total cost	6061.14	.499	4344.48	.357	10530.81	.618
Average cost of coal per ton on floor of boiler room	$1.9113	....	$0.9178	....	$1.255	....

In observing, however, the number of pounds of water evaporated per pound of coal, a value quite constant for all 3 plants, it is seen that with an increase of total number of pounds of water evaporated a marked decrease in pounds of water evaporated per pound of coal takes place. This is, without doubt, due to the fact that during the fall of the year, when the average light and power plant has an increased load throughout, not only the peak but practically the entire 24 hr., the boilers are worked at their maximum capacity, if not, as is usually the case, greatly overloaded.

Lubricant Consumption

The next 2 items, those of "Gal. Engine Oil per 10,000 kw.-hr.," and "Gal. Cylinder Oil per 10,000 kw.-hr.," are, when considering the equipment of the various stations, exceedingly interesting. Due to the bearing which operating conditions have on the consumption of oil in a given plant, we will compare only the amount used in the different stations during a given month, taking for convenience the month of June.

During this period, station A used 3.62, station B, 0.59, and station C, 1.94 gal. of engine oil per 10,000 kw.-hr. generated. When we remember that A is equipped entirely with reciprocating engines, B entirely with turbines and C with both Corliss engines and turbines, we will at once recognize the saving in oil brought about by the use of the modern steam turbine. The same, as may be seen, is true in the case of cylinder oil.

Other Operating Costs

It is hardly with any justice that a comparison be made of the costs of such items as superintendence, repairs, supplies, lubricants and waste, and miscellaneous expense as all who have had charge of the operation of a power plant, large or small, know that these items show a great variation from month to month due to the fact that some months repair expenses are high, while other months they are a minimum, and the only fair way these items can be compared is from year to year and then against the kilowatt capacity rather than kilowatt-hour output.

A word, however, ought to be said regarding the cost of boiler, engine and dynamo operation. Station B, with its steam turbine equipment, shows the lowest amount for these 3 items, both in total costs and cost per kilowatt-hour. This, as in the case of lubricant costs, again points strongly in favor of turbine operation.

Fuel, Costs and Effects

In all but station A, the cost of coal is far in excess of all the other combined costs of operation and maintenance. This may be charged more to the high cost of operation and maintenance (on account of old machinery) per kilowatt-hour than the cost of the coal.

All 3 of these plants are comparatively near the Illinois coal beds and the difference in the cost of coal per ton may more readily be said to be due to the difference in freight charges than the quality of the fuel.

Stations B and C have coal handling apparatus, A has none, resulting in a higher cost for handling the fuel of station A than for the other 2 plants. Stokers are used on all boilers in B, on 12 out of 14 boilers in station C, while A has none at all. This, with the fact that B is equipped with economizers, superheaters and comparatively new generating equipment and control apparatus throughout, explains to a great degree the cause of the low operating costs enjoyed by it.

It will be noted that the boiler operating costs for station C were unusually high during October. This the writer knows was due to poor coal.

New Steam Turbo-Generator Installation

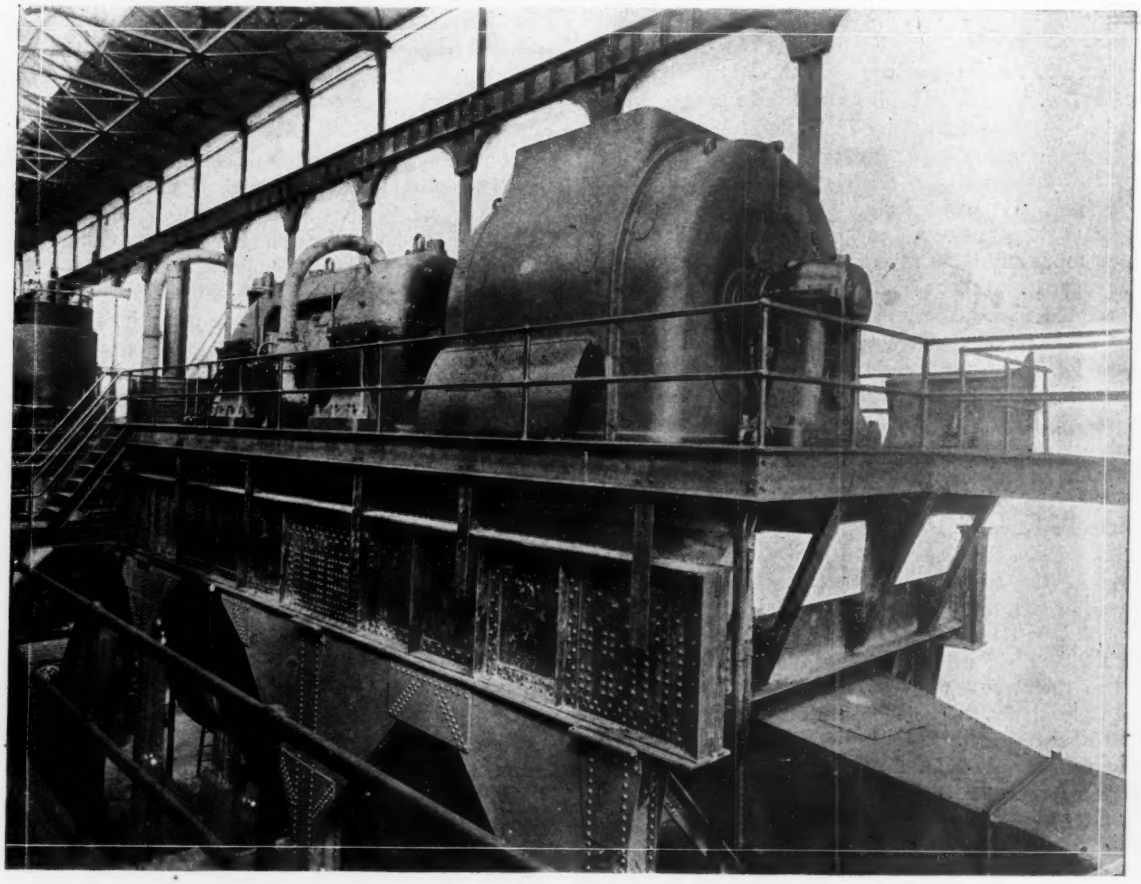
By L. R. W. Allison

THE Public Service Electric Co., of New Jersey, has recently installed at its Marion Station, Jersey City, one of the largest steam turbo-generators of its particular type, a 20,000-kw. unit. This plant is used for electric light and power, as well as street railway service in Hudson County, sections of Bergen and Passaic Counties, and a portion of the company's Essex Division; with the new turbo-generator, it has a total generating capacity of 84,000 kw.

This turbo-generator, Westinghouse type, operates at 1800 r.p.m., and is a 3-phase, 60-cycle, 13,200-volt, horizontal enclosed machine. With overall dimensions of about 40 ft. long, 15 ft. wide, and 9½ ft. high, it weighs 682,000 lb., or 341 net tons. It is mounted in position upon a steel framework 20 ft. high, as shown in the accompanying photograph.

The condensing apparatus is installed beneath the steel supporting structure, central between the columns; these condensers are of the Westinghouse-LeBlanc surface type, consisting of 6000 1-in. brass tubes, each approximately 17 ft. long, and affording a total cooling surface of 25,000 sq. ft. Circulation through the condensers is maintained at the rate of 37,500 gal. per min. by means of a Westinghouse-LeBlanc double suction impeller type centrifugal pump, operated by an individual 290-hp. steam turbine.

This installation is further interesting in effectively illustrating the extensive growth of this company during the past decade. Taking the Marion Station with its present capacity of 84,000 kw. as noted, this is found to be more than twice the output of the entire system of the company in 1903, which was about 40,100 kw. In 1912 this had been increased to 147,400 kw., while at the present time it is approximately 177,400 kw.



NEW TURBO-GENERATOR IN THE MARION STATION OF THE PUBLIC SERVICE ELECTRIC CO. OF NEW JERSEY

Public Service Electric Rates

By Henry D. Jackson

IN the Sept. 1 number of Practical Engineer, H. W. Ashley quoted some figures of mine on the relative costs in central station operation. These figures were taken from the Report of the Gas and Electric Light Commissioners of the State in which these companies operated, and are, therefore, either correct or the companies have made false statements.

Mr. Ashley used this analysis to demonstrate the costs of electricity and to prove, which really needs no proving, that there was a vast discrimination in rates to the advantage of the large consumer and to the great disadvantage of the small.

It is useless to attempt to prove that the small lighting customers are paying too much for the service rendered to them, because many of the small customers are not paying too much; but, as a general proposition, the small consumers are discriminated against to a very great extent, to the advantage of the large one. This can be shown in a number of ways, but primarily can be shown by the fact that the income from the motor load of a large central station is 17.5 per cent of the total income received, whereas the kilowatt-hour load of the motor consumers is 20.8 per cent of the output, and the peak load of the motor consumers is 38 per cent of the total peak. The return from the small consumers, who pay the maximum price, is 38.5 per cent of the total income. The kilowatt-hour load is but 20 per cent, and the peak load is 24.3 per cent. The balance of the commercial lighting returns 25.8 per cent of the income, the kilowatt-hour load is 34.7 per cent of the output and the peak 21.6 per cent. It is quite evident, then, that the small consumers are paying a vastly larger portion of the total income for a very small portion of the total output, as well as a much smaller portion of the plant investment.

Cost of electricity at the switchboard is the operating cost at the station, plus the fixed charges on the plant. To this must be added the other operating charges and expenses, in order to obtain the cost of power as delivered. No electric plant has a unity load factor nor anything near it; such a load factor is of enormous importance to the central station, as it reduces to a minimum the fixed charges per kilowatt-hour; and for this reason, all central stations make a determined effort to improve their load factor. Most of them are doing it through the development of the large power loads and large lighting loads, with the avowed intention of utilizing apparatus which would otherwise be idle. During the summer months, they do succeed in accomplishing this to a large extent. Unfortunately, however, in this section of the world the winter load is by far the longer, and the one which is most effective on the load factor. During this period the power load and the large lighting loads of the stores and factories lap over the ordinary commercial lighting load, thus requiring that apparatus be installed both in the station and in the streets exactly equal to the combined loads. This being the case, there must be, in the station and in the streets, apparatus equal to the large power and lighting loads in order to supply these loads. The fixed charges on this apparatus must be paid, and the only people who should pay it are those who are responsible for it.

The central station cannot obtain these large loads without fighting for them. It must prove to the customers that they cannot produce power at a price to compete with that of the central station. To do this requires a force of competent engineers and solicitors who are capable of making such representations to the large consumers as will make them believe such is true. Such men are expensive to obtain and equally expensive to continue in their employ, so that the expense of obtaining such loads is enormous, as is the expense of continuing it. Such expenses would not exist if the stations did not go after such loads, and, therefore, it should be evident that the expense of such men should be paid by those who make it necessary.

Taking these items into account, it must be fairly evident that the cost of such men would equal, if not exceed, the clerical and other costs of handling the small consumer's business, so that the average cost of power as delivered would be nearly if not exactly the same to the large customers as to the small.

This being the case, it would be interesting to note the comparative return of such customers as compared to the average cost. The return to this large station for the power was approximately 4.8 cents a kilowatt-hour, and the average cost of the station for power to these plants, including all charges, was 4.83 cents—thus showing that the power load as a whole is a losing game for the central station, unless some one else is charged for the fixed costs or the operating costs of the engineering staff. The return of the small lighting load is 10 cents a kilowatt-hour; the cost as before 4.83 cents; and the return of the balance of the lighting load is 3.875 cents, whereas the costs as before are 4.83. Other loads, such as power to other companies and power to street railways, are sold at equally low prices. That to other companies is 2.87 cents, where that to street railways is 1.72 cents, in spite of the fact that both of these are peak loads.

It might be said that criticism of anything is valueless, unless it is constructive criticism; and in this I heartily agree,—but is not the criticism above constructive when it requests a square deal between the central station and all of the customers?

It is usually believed that power is charged for in accordance with certain definite conditions which will bring about a profit to the central station, and that the cost of power to the consumer is determined by other conditions than the cost of power to the consumer if he generates it himself. This is by no means true. The cost of power to the small consumer is arbitrary as long as he does not take steps to produce it himself. The minute this occurs, the cost of power drops to a point equal to or lower than this consumer can produce it, and it makes no difference whether the consumer is large or small, if he can produce power at a low price. He is likely to be offered a price equal to it or lower than it, by the central station, to obtain the load. It may not be done directly, but it is done in one way or another. One of the methods of maintaining control of the situation might be as follows:

Suppose a number of people in a large building unite to build a power plant, such as is termed a block plant; and they notify the central station that they propose to cut out its service. The central station immediately gets in touch with the leading spirit of this community and offers him power at a price equal to that which he thinks he can generate it. It agrees to leave the meters in service and take care of them, to install a meter for the entire load, charge him for this load at a price equal to what he can produce it for, and let him sell to the other customers at whatever price he can obtain.

Conditions have not changed, the number of meters that the company has to take care of is increased by

one, and its investment charge is the same as before. The only difference is that it does not have to read the meters of all the customers nor make out the bills for them. Total costs probably will not have been reduced more than $5 a month for such service, and yet the price of power is frequently cut in half. This is justified on the basis that it is wholesale service as compared to retail, but in no other commodity is it possible to obtain a discount of 50 per cent for wholesale service when the other conditions remain unchanged. No more power is sold, the peak load is not changed, nor is the time of delivery changed; simply charging one man for the power instead of a dozen or a hundred.

When it comes to a large power plant, the cost of electricity for these plants is determined solely and entirely by what it costs these plants to generate it themselves. It has no bearing whatever upon what it costs the central station. Such business can be justified only on the score of the tremendous advertising feature of obtaining such loads and upon such basis only, is it secured.

To make this criticism further constructive, it is advisable to show wherein the central station could obtain a load which would be equally or more productive than the load they might be compelled to drop, that is such loads as are costing more than they return; such a load is quite possible to obtain. Any large plant, or in fact any electric plant, has potentially a tremendous load in the form of cooking, heating and such general utility work. The power for it must be sold at a low price, that is, low enough to compete with the method now employed for such purposes. In other words, the price must be low enough to compete successfully with gas and coal. A price of 3 cents a kilowatt-hour is low enough to compete with either gas or coal when gas is 80 cents per 1000 cu. ft., and coal in the neighborhood of $6 or $7 a ton.

The possibilities of such a load are enormous. With 15,000 customers utilizing stoves and ovens, also irons, washers of all kinds, hot water heaters and devices for heating the room in the spring and fall, it would require 45,000,000 kw.-hr. in the year, based on the average family of 4 using 3000 kw.-hr. the year. As the average family is much larger than 4, these figures are a minimum and conservative. On this basis, the total return would be $1,350,000, of which $900,000 would be profit, for the total cost of production and distribution would not be over 1 cent a kilowatt-hour, as the interest charges on the apparatus are all paid by the peak load users, and this apparatus could be compelled to be used solely during the non-peak load. Compare this income with the power load income of one very large plant, where the total load is 20,000,000 kw.-hr. per year, and the return is but $961,000. The average return, therefore, is 4.8 cents, whereas the costs, including the fixed charges which have to be made upon the power load, owing to its lapping over the other loads and the fact that it is a peak load, are 4.83 cents. Which is the better load for the central station? In addition, this character of load is of benefit to the community,—not to a few,—but to the community as a whole. It allows the majority of the users to obtain a service at a fair cost, returning a handsome profit to the central station, and eliminating much of the nuisance of housekeeping, which is the aim of all communities.

Jeremiah Judson, C. E.

A Rope Drive in a Tannery

NEXT day, as soon as the boys had stretched themselves over the requisite amount of the good things of life to supply the necessary stimulus for another 5 hr., they loaded up the several brands of smoke consumers with an equally diversified number of brands of alfalfa, and with a good draft, went over to the big rope wheel again to note the progress of the work.

Earnie Bootzberger, who ran the pit lathe, had completed the work that morning, and as the wheel was of the built-up type, with a sectional rim and 10 independent spokes set into the 2 halves of the hub on the engine shaft, the matter of removing 160 turned bolts from as many reamed holes was some task.

These bolts were all the way from 2.5 by 12.5 in. up to 3 by 29 in. A special rig had been made to draw them with the aid of the 5-ton hook on the crane, and advantage was taken of the noon hour to remove these bolts, and the several sections of the rim, while the shop was not running, and thus reduce the possible time lost in "holding up" the machines while waiting for the crane during working hours.

Thus it was that the usual number of the boys were sitting on a No. 6 frame smoking and watching the operation, as old Pete Holverson deftly yanked out the bolts with one hook and with the other lifted the sections of the rim out of place and piled them up on the floor.

The conversation "drifted" (on purpose, of course) to the conversation of the previous day, and Cadwell, removing his Missouri gas producer long enough to expel a whiff of smoke, and spit through a core hole in the frame, casually remarked: "Oh, Jerry. What was that you were about to say yesterday when the whistle blew?"

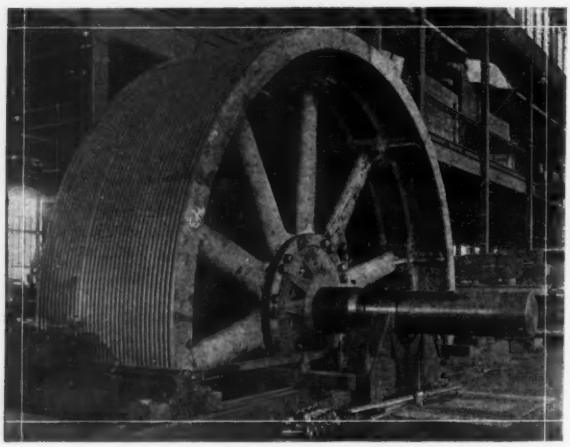
Jeremiah removed his briar and pointed at the wheel in question, with the stem, hitched up his right sleeve, crossed his legs the other way, and after puffing a few times to insure proper combustion, said, as if the conversation had been interrupted by only a few minutes instead of some 24 hr.: "Oh, yes. Let's see, what was that now? Oh, I remember now. That rope wheel reminds me of an experience I had once a number of years ago with a rope drive that tore up about everything but the well and the building site.

"I was with a firm at that time that was called upon at more or less frequent intervals to send men, tools and equipment out to do all sorts of repairing. In that town, there was a tannery, the mechanical destinies of which were presided over by a fellow named Falk.

"Falk knew rope drives, and don't you forget it. He was a genius in every sense of the word. A few years after he took hold, the old plant began to play out, owing partly to age and partly to the increase of the business over and above the original capacity, by a large margin.

"So Falk began to scheme and get all the dope loaded into the verbal gun, ready to fire at the manager at the first opportunity, which soon presented itself when something that was overloaded let go at the wrong time and spoiled a lot of leather, owing to the breaking up of the 'system.'

"There was the usual interview and the usual 'why' fusilade from the office, and then Falk cut the fuse short and touched off the dope gun. It busted right in the office, and was to the effect that with the exception of 2 boilers, everything would have to be new: engines, shafting, many machines throughout the tannery, and a lot of other things.



ROPE WHEEL WHICH BROUGHT FORTH THE STORY

"Of course, as usual, they said he couldn't have it all; that is, all at once. I wasn't there till 9 yr. later, and don't know exactly what Falk said, but I guess it was about like this:

" 'Gentlemen, how many times have we had a shutdown since I have been here on account of your old, rotten equipment, and what has been your loss in spoiled skins? You don't know? I thought so. Well, I'll tell you.' And boys, do you know, he did tell them. The Super told me so when I was there later, as I will come to directly.

"The loss of skins was so great that it would not only pay the interest on the investment, but would buy a new engine, rope drive, and part of the heating system. In other words, the firm had already paid out the money for the new equipment (in losses) and still did not have the new machinery.

" 'Well, Falk, we will get a consulting engineer here to look into the proposition and lay it out for——,' began the old man.

" 'Not by a jug full, you don't,' replied Falk. And come to think of it, he didn't say jug full either. It was something stronger—more emphatic.

" 'No you don't. I have got it all doped out what we ought to have, and if I don't know, after being here 6 yr., 7 days a week, and about 25 hr. a day, how do you expect a man that never saw a tannery except from a street car, to come in here, and in about 5 hr., lay out a power plant, heating system, line shafting and lighting system?

" 'Here are my plans. Take them or leave them. I want so-and-so much more wages and full swing here or else I want my time.'

"And do you know boys, the firm stood for that and let him have his own way. All they did was to pay the bills. Well, that is as near as you can come to it.

"They ran through the skins that had been started and shut down. In the meantime, all of the new equipment had been ordered and most of it was on the ground. Then things began to hum.

"Owing to the fact that the boundary line was on several angles and the building, of course, built to the line, universal joints were used at several places in the shaft. Don't forget this.

"Of course there had to be a definite time to start up so as to get the skins started far enough ahead. Falk set a certain day, some time in the future, and bent all his energy toward that point. When the day arrived, there was started up the finest layout of rope transmission for completeness that I ever saw, before or since.

"And for 9 yr. that outfit never had so much as a piece taken out of a rope, and the firm never lost a second of time—that is, till it happened. In those 9 yr., the saving from lack of breakdowns, etc., put the firm on its feet so to speak. They rewarded the author of all their success substantially and let him run things down below. They stayed in the office, hustled for business and paid the bills.

"But to come to the real story itself. The flywheel was not near so large as that one there, but it had plenty of ropes on it to the main line shaft just outside the wall. On each side of the driven pulley was a friction clutch and another rope sheave, each operating line shafts on the step-off principle; that is, each set of ropes ran 2 line shafts, half of the ropes to each, beside each of the secondary driven rope sheaves, was another clutch.

"Now, boys, get this all in your mind; just outside of the last auxiliary line shaft on one side was one of these universal joints to change the direction of the shaft, owing to the irregular building line, which a little farther down changed again to about parallel to the original line.

"This crooked line shaft drove a number of machines presided over by those future aldermen, congressmen and presidents, known as Hunks, Wops, and Flunkies, depending on the locality. These fellows couldn't talk English nor understand it. They couldn't even laugh in English, but they had observed English ways quite well, only in this case they did not observe quite well enough.

"It sometimes happens in the best regulated factories, that it is necessary to put on a belt by the time honored method of making a wrap around the belt and pulley with a rope's end and as soon as the pulley revolves once, the loose end will drop out—and the belt is on. With care and a cool head, this is perfectly safe. But the Wops!

"They had so far progressed towards citizenship that they thought they could put on their own belt, so they went at it. They threw out the clutch for the time being, placed the belt on the pulley, and *tied* it there with a 1-in. rope and a hard knot. Then one of the future senators jammed in the friction clutch.

"Falk was in the engine room when he heard the engine grunt a little, the governor dropped a little, then a terrible thumping smote his ear. Stepping to the door leading to the factory he saw the air full of shafting, broken hangers, belts, tangled ropes (from the short drives), counter shafts and Wops, and the noise was such as might be heard at the charge of the Bulgarian cavalry.

"Grasping the lever at the main line shaft, Falk threw out the clutch leading to the scene of hostilities, and stepping over, was about to count the slain, when to his surprise, there wasn't even a wounded Hunk. Taking a look at things, he found that by disconnecting the universal coupling at the last shaft, he could run all of the works except that one line, and in 10 min. he had done the trick and had things going again.

"Now, he had time to look things square in the face. There was some 100 ft. of 3, 2.5 and 2-in. shafting with the counter shafting and all the connecting belting and pulleys down on top of the machines, big 26-in. hangers broken off or pulled out at the lagscrews, pulleys broken and cain raised in general, but the strange part of it all was that there wasn't a man hurt.

"Where did I come in? Well, this was too much of a task for any one man to tackle and get it cleaned up in any sort of time, so our firm was appealed to. Falk phoned up the sizes of the shafts, keyways, hangers, etc., and for a couple of men. Two of us went down, and by the time we had the wreck cleared away, the hangers and shafting arrived.

"This we put up in record time, put on the split pulleys, belting, etc., fixed 1 or 2 machines that had been hard hit, and were running again in about 2 days."

"Didn't you get any sleep?" asked Caldwell.

"Sleep?" asked Jerry, surprised. "No, you can sleep when you haven't anything else to do. But there goes the 1 o'clock whistle again." And we all went back to the mines.

(To be continued.)

A System of Daily Elevator Inspection

ELEVATOR REPORT OF HOME INSURANCE BUILDING. BY C. E. ANDERSON

ALL elevators in the Home Insurance Building of Chicago are inspected and tested every morning and a written report is made weekly for each individual elevator. This, in my estimation, is an excellent method of keeping a check on the elevators to see that they are in a safe and good working condition, keeps a record of the repairs made and material expended on the elevator during the week.

Commencing at 6 o'clock in the morning, the elevators are first oiled wherever necessary and the grease cups on the sleeves are either filled or screwed down, as the case may be.

In oiling, the nuts and bolts on the operating mechanisms of the elevator are examined to see that there are no loose nuts or broken bolts, the sheaves are also examined for cracked spokes. After this is done, the car is run up to the top, then down to the bottom, to see that the limit or automatic stops are working. While this is being done, the lifting and hand cables are examined for broken strands or weak places. After everything about the elevator has been examined and oiled and is in seemingly good safe operating condition, the safety dogs, or automatics as they are sometimes called, are set to see that they are

HOME INSURANCE BUILDING

ELEVATOR INSPECTION REPORT.

CHICAGO, 7/11 1914

EDWARD C. WALLER, AGENT.
HOME INSURANCE BUILDING.

Dear Sir:—I have inspected Elevator No. 6 and report the same in the following apparent condition

MACHINERY, CYLINDER, VALVES, ETC.	All in good working order Repacked piston 7/9/14
OVERHEAD SHEAVES, SUPPORTS, ETC.	Good order Renewed bronze bushing in outer lifting sheave
POSTS, GUIDES, ETC.	Good order
SAFETY APPLIANCES	Good order
OPERATING MECHANISM, ETC.	Good order
CABLES	Renewed hand cable due to broken strands all other cables in good condition.
DOORS, ETC.	New latches needed in doors on 7th and 9th floors
PACKINGS.	Good order.
AUTOMATIC LATCH OR STOP	Tested and found in good working order.
CAR	New linoleum needed on floor of car
PIPING, ETC.	Good order.
GENERAL CONDITION	The general condition of this car is excellent.

REMARKS:
Elevator #6 ought to be fitted with a more modern type of guide lubricator.

John Doe Chief Eng.
ENGINEER HOME INSURANCE BUILDING

ELEVATOR REPORT OF HOME INSURANCE BUILDING

in working order and also that the governor is properly set to release the dogs so that they will set and stop the car at a predetermined speed.

After everything has been tried and found in good working order, the car is turned over to the operator and is ready for the day's run.

These elevators are of the vertical hydraulic type, and are about 30 yr. old. They are in good working order and safe condition, which speaks well for the operating force which has taken care of them during these years.

IN SYDNEY, AUSTRALIA, a 16-hp. engine has been running since May 6 on sewer gas.

Water Line of Threaded Pipe

METHODS AND TOOLS EMPLOYED IN LAYING LARGE SCREW LINES. BY H. L. SHERMAN

A WATER company that supplies water for domestic and manufacturing use on both sides of a navigable river, decided to lay an 8-in. screw water line across the bottom of the river. This was necessary on account of the bridge that carried the water line being condemned.

The first step was to secure the consent of the war department, which has control of all navigable streams. This was secured under certain conditions, one of which was a trench 4 ft. deep in the bottom of the river. The trench was dug with a dipper dredge which worked from bank to bank, lining up its course by poles set in the bank. Right here I would like to say that a trench for this purpose should be dug with a slight curve arching upstream, which will allow the pipe to be supported by the side of the trench downstream without putting any undue strain on the pipe line. A dredge of this type has a heavy wooden beam at each corner standing vertically. When these are let down it rests on the bottom of the river like a great table.

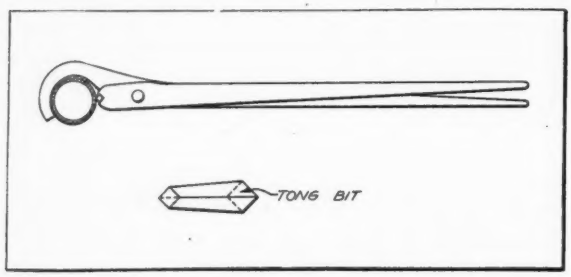


FIG. 1. LAY TONG AND BIT

The material taken from the trench was loaded into scows and towed away and dumped in a deeper part of the river so as not to obstruct navigation.

The approximate width of the river at this point is 600 ft., while the depth is about 9 ft. The ditch was dug down to the bank on each side. The pipe was laid on one side down to the water's edge. Next, a coal boat bottom was secured and loaded with the pipe and material necessary to reach from bank to bank. The coal boat bottom is practically a raft 100 ft. long by 20 ft. wide and has gunwales about 1 ft. high. Poles were used to put the boat into the proper position for commencing work and to aid in moving the boat from time to time. Castings of perhaps 200 lb. were used for an anchor. The boat was placed bow and stern up and down stream, the bow being about 30 ft. upstream above the end of the pipe already laid.

About this time 15 men and a foreman were secured in addition to perhaps a dozen that were at work already. This gang of men had just finished a pipe laying contract and were quite an aid just at that time.

For the benefit of those who are not familiar with the tools and methods employed in laying large screw lines I will go into details.

First, the only tong that is worthy of the name for this purpose is the Lay, or an imitation of it. This tong was invented by the man whose name it bears perhaps 35 yr. ago and is in general use today, and may never be superseded. Like the pick, shovel and plow, it is the same now and forever (pretty nearly). Figure 1 is a sketch of the Lay tong.

There is a taper square bit, or some call it a key, that can be changed 4 times, each cutting edge gives a sharp tong until, when all edges are dull, it is thrown away. The sketch will give a fair idea of the proportions of the tong. A strong man can carry a pair of 6-in. tongs, but he won't very far. If you need the tongs very badly and need the man, be gentle when you mention the idea of going after them.

A crew for laying 8-in. screw pipe should consist of about 25 men, although it can be laid with less, but

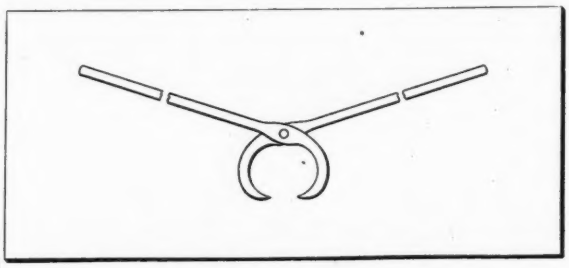


FIG. 2. PIPE PICKUPS

not so well or so rapidly. Six or 4 forward tongs are used besides the back-ups, or tongs that are put on to keep the spring out of the second joint and keep it from turning. Three men are on each pair of tongs, 2 men hold the jack, 1 man hammers collars, striking the collar to give time to the stroke of the tong men.

One man stabs or steers pipe, one cleans threads and takes off thread protectors, and paints collars, on the inside. Black paint like coal tar, only thinner, is now usually used for this purpose. White lead was formerly used nearly altogether, but the black-jack "ball up" at the end of the thread inside of the collar is painted and stops leaks. There is no use painting the pipe thread for stopping leaks from the inside.

There are also men to carry pipe and laborers for various uses. For carrying pipe, "pick-ups" are used, as shown in Fig. 2.

Another crude but effective tool is the jack, which is usually a piece of 4 by 4-in. oak with pins of 1¼-in. round iron driven through bored holes in the timber, which is usually shod with iron to resist the wear of the turning pipe.

Accompanying is a sketch of the jack, jack board, and belly board, this latter being used as a brace for the jack, both resting on another board when used to lay pipe in a trench.

A properly designed jack can be reversed, while the jack board may be laid down on its back or stood on end. The combination of the jack board and jack is used to give the exact height and position necessary to hold the pipe in line for screwing in.

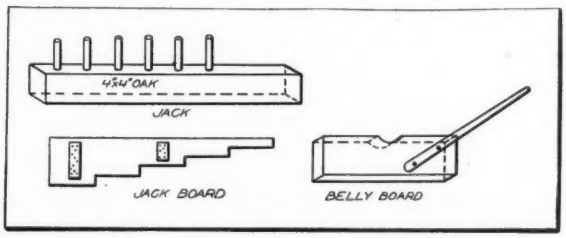


FIG. 3. JACK, JACK BOARD AND BELLY BOARD

The boat being placed in position, the pipe is entered into the collar at the water's edge, raised to line with the other pipe and caught by the jack man, while the man with the jack board puts it in to hold the jack.

The men start the pipe with their hands for 2 or 3 turns, then throw a couple of loops around the pipe with a rope, strike out all but one on one end, heave forward and back, the one man taking up the slack. They screw the pipe in this way until it tightens up. Then 2 pairs of tongs are thrown on and the real work starts. At first the tongs work opposite to each other, one pair going up while one comes down, keeping the pipe rolling continuously—breaking stroke, they call it, and I wish to say that it is a hard job to break in a green crew to break stroke.

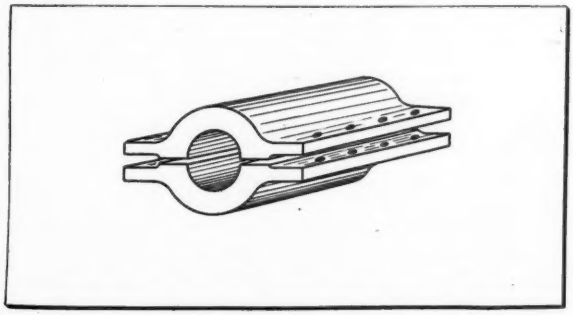


FIG. 4. A RIVER SLEEVE

Before the pipe gets tight the second pair of tongs is put on and each pair strokes with its partner, keeping time with the strokes of the hammer, each pair of tong-crews in friendly rivalry trying to hang up the other crew. When the pipe goes too hard, all give a few strokes together, then the foreman gives the signal with the hammer when the joint is up.

A heavy split sleeve is now put around the pipe and over the collar in such a way as to reinforce the pipe in the weakest place. This sleeve is commonly called a river sleeve, and weighs about 450 lb. for an 8-in. pipe sleeve, 8 1-in. bolts being used to hold the sleeve together. The length is about 20 in.

The 2 halves of the sleeve being in position and bolted up, the boat is ready for a move. Most of the men get hold of the pipe while a man or 2 use poles; the boat is shoved out the length of a joint. The anchors are sometimes handled by men in a skiff, and sometimes just lifted and moved as the wind and current will permit.

This process is repeated until the other bank is reached, which in this case was about 3 days. Care should be exercised to keep the pipe in the ditch, and frequent soundings are necessary. The current will fill the ditch with floating sand and mud after a few rains. When necessary to repair the line it must be dug out, using a hoist boat with a clam shell or orange peel digger.

Burning Lignite

AT the meeting of the Southwestern Ice Manufacturers Association, D. J. Beeman, of Waco, Texas, in the course of a paper on Economy of Fuel by Use of Forced Draft, gives the following data in regard to the burning of lignite.

Forced draft and hand-fired furnaces are the ideal combination for burning lignite, in order to get efficiency and rated capacity of the boiler. The problem in a large plant using lignite is the increased cost of labor, due to the greater quantity of fuel to be handled, and also the greater amount of ashes to be removed. As the coal is noncoking, a special grate bar is necessary in order to avoid losing too much coal through the bars. Our plant uses a special design of the type commonly called "herringbone," which will burn either lignite or slack coal.

Forty square feet of heating surface to a square foot of grate surface has best suited our needs, with bridge wall built 4 in. higher than the standard for bituminous coal, in order to get a thorough mixture of gases before leaving the furnace. Thermometers were installed in the uptake, and close attention paid to keeping the escaping gases from all boilers as nearly the same temperature as possible, not letting this temperature get above 660 deg. F. Differential draft gages were used, so piped that a reading could be taken from any uptake or from any ash pit, and the draft in the uptake was never allowed to go above 0.4 in., averaging 0.35 in. The forced draft was regulated according to the thickness of the fuel bed, to give as nearly a balanced draft as possible, about 0.03 in., which gave the highest per cent of CO_2, as shown by regular gas analysis, at about 8 to 10 per cent. Firing a hand-stoked furnace with a perfectly balanced draft, was found impossible because of the intense heat, and the fact that flames would shoot out of the fire door whenever fuel was added.

INSTALLATION OF NEW MACHINERY at the Natchitoches (La.) power house has been completed. It consists of a Skinner automatic engine, connected with a 6-kw. exciter and a blue Vermont marble switchboard for the generator.

WORK ON THE 2 UNITS of the new power house of the Tucson (Ariz.) Gas, Electric & Power Co. started recently and the buildings will be completed within 2 months.

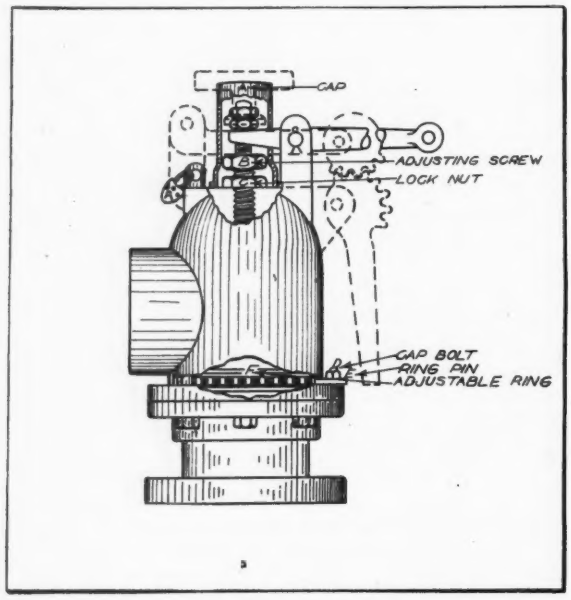
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Directions for Safety Valves

In the issue of Aug. 15, on page 840, we note the question and answer in regard to safety valves popping at 75 lb. and blowing down to 50 lb. before closing, and we give herewith our directions to overcome trouble of this kind with our iron body valves, also directions for installing pop safety valves.

In ninety-nine cases out of a hundred when we have complaints that anything is wrong with a safety valve, we find that something has gotten on the seat, either red lead, boiler scale, chips or sediment of some character, and we believe in all cases when a safety valve does not give satisfactory results, the cheapest and best way is for the user to return the valve to the manufacturer, as there isn't one engineer in a hundred who understands the way to make a safety valve work properly. This seems a rather bold statement, but we have found it to be the fact in our large experience.



LONERGAN SAFETY VALVE

Another cause for the trouble with safety valves is that, instead of connecting them up in a vertical position direct to the dome of the boiler, we find that very often they are connected to a pipe leading several feet away from the boiler, which runs to the engine or pump, thereby causing a pulsation in the pipe, which causes the safety valve to chatter and pound itself to pieces.

To change popping pressure, remove cap A, loosen locknut C, turn adjusting screw B to the left or up to decrease popping point, and to the right or down to increase popping point. One quarter turn will change popping point from 5 to 10 lb.—after making change tighten locknut before trying valve—the blow-down should be about 4 lb. before valve closes.

To change blow-down, unscrew cap bolt D, remove ring pin E and take a pointed file and turn adjusting ring F to the left (left hand rotation) or up to increase the number of pounds blow-down, or to the right (right hand rotation) or down to decrease the number of pounds blow-down. Move ring only 2 or 3 notches at a time—replace cap bolt D and ring pin E before trying valve.

The range of valve springs is limited and to change the pressure more than 10 per cent a new spring should be purchased.

If the valve shows a tendency to chatter, adjusting ring should be screwed to the left or up.

To prevent strain on spring when testing boiler under water pressure, a testing yoke should be used.

Each valve sent out from the factory has been tested and will open at the exact pressure to which it is set.

Blow out your piping before connecting, and avoid the use of pipe joint grease or lead. Note this carefully, as practically all valve troubles can be traced to such a cause.

The hexagon nut on the valve base is provided for the use of a wrench in screwing valve into position. Do not use a wrench on the valve cover.

J. E. Lonergan Co.,
M. A. Hudson, Vice Pres.

Minnesota Examinations

In Practical Engineer for Sept. 1, there came to my notice an article headed Minnesota examinations, signed by F. M. J. I feel it my duty to bring to the attention of readers 2 misleading statements contained therein.

The writer gives a list of 50 questions, which he states were asked of him, by a Minnesota examiner when he applied for a first-class license, and concludes his article by making the following statement:

"Anyone having had at least one year's experience as a fireman or oiler, who can answer the foregoing questions correctly, will be granted a first-class license in the State of Minnesota."

As to the first part of this statement, I should like to ask F. M. J. where he received the impression that only one year's experience as a fireman or oiler would qualify a man for a first-class license in Minnesota. The state law reads as follows:

"No license shall be granted to any person to act as first-class engineer who has not taken and subscribed

an oath that he has had at least 3 years' actual experience in operating steam boilers and steam machinery, and whose experience and habits of life are not such as to warrant the belief that he is competent to take charge of all classes of steam boilers and steam machinery not exceeding 300-hp."

As to the latter part of his statement, I fail to see how any man worthy of being called an engineer could expect to get by, in any city or state examination, by simply learning by heart the correct answers to the 50 questions referred to in F. M. J.'s article.

As far as I know, the state examinations in this state do not have any stated list of questions to ask an applicant, when applying for a license, and it seems very possible that the applicant who follows F. M. J.'s advice and attempts to get a license on the assumption that he knows the correct answers to 50 set questions, might receive a severe jolt were the Examiner to ask him 50 questions entirely different from those which he had beforehand learned by heart. The progressive engineer who is anxious to get ahead in his profession will not bind himself simply to learning the correct answers to any set list of questions—but rather will start in at the bottom by mastering the fundamental principles upon which modern power plants operate, and having thus far advanced, he is ready to take up the construction and proper maintenance of steam boilers and steam machinery in general.

A. C. Brown.

Operating Taylor Stokers

I read the article on Stoker Tests Under Average Operating Conditions, by Horace Judd, in the Sept. 1 issue, with considerable interest. I have been operating this type of stoker for the past 4 1-2 yr. as assistant engineer, and our method of operation differs somewhat from that stated by Mr. Judd. There are 1 or 2 points on which I would be pleased to have him and others comment.

Ours are 2 retort stokers placed under 175-hp. Geary water-tube boilers, but without the extension grate of which he speaks, which may be raised to prevent the coal from sliding onto the dump plate. The load on the boilers is heating and furnishing steam for the generating units. The load from 6 a. m. to 10 a. m. during the heating season ranges from 200 to 300 per cent of the rated capacity. It then drops to about 100 per cent capacity with a slight peak between 4 p. m. and 7 p. m., then down to about 50 per cent during the night. The coal used is George's Creek crushed mine run. I note that he dumped the fires at intervals of 1 to 3 hr.

We have considerable trouble from clinkers sticking to the side walls, and on account of making smoke when cleaning, it is necessary to clean the fires after dark, say 7 p. m., and again before daylight, say 4 a. m. The fires are burned low and the refuse pushed down onto the dump plate. This is left about an hour to give the unburned coal time to become burned as much as possible, then dumped. The refuse on the dump plate is also dumped about noon, but the fire is not disturbed except to break it up a little. Would it be more economical to dump the fires at shorter intervals?

The forced draft fan engine is controlled by a "Locke" damper regulator, which is not connected to the dampers. The speed of the fan is from 150 to 450 r. p. m., and the regulator works on a variation of 2 lb. steam pressure. This produces a pressure in the wind box of from 0.5 to 2.5 in. of water. Would not the furnace be more economical if the speed of the fan were constant instead of variable; that is, have the speed of the fan so regulated that the air pressure in the wind box would be constant at a given load but changing directly as the load changed? This might require hand regulation; but it seems to me that when the fire is low and the steam pressure drops, which causes the fan to speed up, altogether too much excess air is blown into the furnace at a time when it cannot be used, which with a constant air pressure would not be the case.

We formerly had considerable trouble in getting the right ratio of speed between the stokers and the fan engine which drives them. This was changed so that the stokers are not cut out with the clutch but run continuously. Does this give better economy than when cut out for a few minutes at a time, at intervals when the load is not heavy?

The clutch is thrown out only when cleaning the fire, and the damper in the wind box is regulated to give the same pressure in each furnace. On our stokers the stroke of the lower plunger is adjustable. It seems to me that the length of stroke of the lower plunger will determine to some extent the amount of partly burned coal that goes onto the dump plate. About what should be the ratio of length of stroke between the upper and lower plunger for best results?

Another trouble we had was in fine ashes being blown out of the stack which settles on the marble building, giving it a dirty appearance, but there is no smoke except during cleaning time. If the breeching damper is partly closed, the gas fumes become unbearable in the boiler room when the fan is running full speed. Would a constant air pressure in proportion to the load on the boilers be apt to reduce the amount of fine ashes blown out of the stack? As stated above, the fires are cleaned by barring off the clinkers twice in 24 hr. Would it make less work for the firemen to bar them off say 4 times in 24 hr.

We have been unable to clean the fires without making considerable black smoke which is very objectionable here. What method of cleaning has been found best as far as absence of smoke is concerned?

H. J.

Selecting a Flywheel

Recently, the writer purchased a 16 by 36-in. second-hand Corliss engine to develop 200 hp. in a cotton mill. This engine was originally provided with a wooden wheel, which for various reasons was not desirable in our case. Therefore, the writer decided to obtain a cast-iron wheel in halves, and the following is an outline of his method.

To obtain good steam economy in a simple noncondensing engine, a piston speed of about 600 ft. per min. is desirable, and, as the stroke was 3 ft. or 6 ft. per revolution, to obtain a speed of 600 ft. per min. the engine must run $600 \div 6 = 100$ r.p.m.

The jackshaft to which this engine is belted has a 56-in. pulley and runs at 257 r.p.m., so the diameter of the flywheel should be $257 \times 56 \div 100 = 143.92$ in., dividing this by $12 = 11.99$ or 12 ft. This gives a rim speed of $3.1416 \times 12 \times 100 = 3760$ ft. per min., which is well within the safe speed of 6000 ft. per min., which is as high as is desirable to run cast-iron wheels.

A common method to obtain diameter of wheel is to make it 4 or 4.5 times the length of the stroke. The diameter of the hub is usually twice the diameter of the shaft, and an inch or an inch and a half narrower than the rim.

The weight of a wheel is assumed to be concentrated in the rim, and whatever the weight of arms and hub, is extra, making regulation closer. The desired weight of the rim for any service may be figured from the following formula. $W = C \div D R^2$.

W = weight of rim in pounds per horsepower;
D = diameter of wheel in feet;
R = number of revolutions per minute;
C = a constant as follows:

Rolling mill, 6,500,000,
Electric service, 5,500,000,
Textile mills, 5,000,000,
Ordinary work, 4,000,000.

In our case, we have $5{,}000{,}000 \div (12 \times 100 \times 100) = 41.6$ lb. per hp., and for 200 hp. we have $200 \times 41.6 = 8320$ lb. In estimating, it is generally considered that the weight of the arms and hub is 0.33 per cent of the rim, making the weight of the wheel 1.3 times the rim weight, or $1.3 \times 8320 = 10.816$ lb.

To obtain the width of face, we must determine the width of the belt in inches and make the rim an inch or 2 wider.

The belt pull is 33,000 times the horsepower divided by the speed of the wheel rim. $33{,}000 \times 200 \div 3760 = 1760$ lb.

$$W = \frac{33{,}000 \times \text{hp.}}{D \times 3.1416 \times r} \times 2 \div f.$$

W = width of belt in inches.
D = diameter of wheel in feet.
r = number of r.p.m.
f = safe strain per inch of width of belt.

$33{,}000 \times 200 \times 2 \div (12 \times 3.1416 \times 100) = 3458$. Allowing a strain per inch of width of belt of 140 lb., the width of belt will be $3458 \div 140 = 24$ in. The wheel face will be made 25 in. wide. The arms are preferably elliptical with the width of the arm at right angles to the face of the wheel, to reduce the loss due to windage. A return flange should be provided on each side of the rim to strengthen the rim, and also a flange in the center. Wheels over 10 ft. in diameter are made in halves to reduce the shrinkage strains when cooling to a minimum.

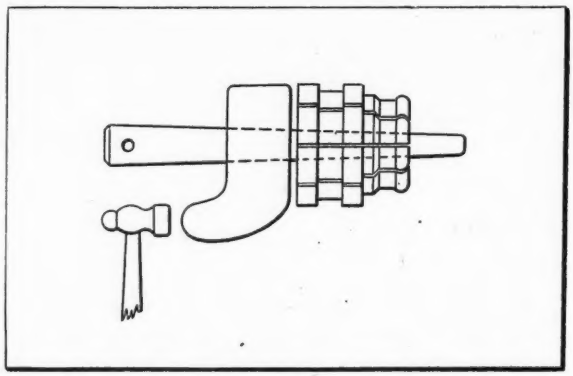
RECEIVER.

Retubing Boilers

IN CONNECTION with J. C. Hawkins' article, "Retubing Boilers," I wish to say that on account of recent advances in tube expanding, the wedge expander or "prosser" is gaining in favor over the roller type.

Both types have their advantages, but Mr. Hawkins speaks only of the advantages of the roller type, which he says is preferable. The prosser, however, has advantages in that it is not so liable to thin the tube through too much hammering, although it may be a trifle harder on the tube sheet, sometimes cracking it. Careful usage of either tool, though, will do the job well.

To show that the prosser is often favored, I have seen specifications on tubing boilers which stated explicitly that roller expanders should not be used, especially on repair work, because rollers are liable to ruin the bead.



KNOCKOUT LUG FOR PROSSER TUBE EXPANDER

A disadvantage that has been inherent in the prosser was the sticking of the mandrel after driving and the difficulty of extracting it. This has been overcome by the construction of a "knockout," which slips over the prosser mandrel as indicated in the sketch herewith. By merely rapping on the knockout lug, as shown, the tightest mandrel is made to back out surely and quickly. This is a great time saving feature and makes expanding by use of the prosser absolutely safe. Formerly, extracting the mandrel by banging it sidewise caused many breakages and bodily injuries.

N. G. NEAR.

Blowing Down Boilers

AFTER A CAREFUL study of Mr. Bohe's article in the Sept. 1 issue, I should like to say a few things about blowing down boilers. I have no doubt that there are conditions where blowing down works an injury to boilers and adds some expense. Anyone trying to operate boilers in our central western state without blowing down 2 or 3 times a day, however, would soon have a boiler full of mud and by blowing down often, the boilers can be run as much as a week without washing; this water contains large quantities of alkali and it is hard to keep the boilers from foaming. In cities where blowpipe is connected to sewers, it cannot be done and as to blowing away compound, I believe a certain amount of compound is intended for a certain amount of water and after that the old compound in the boiler does no good, but may as well be blown off and a new batch fed in.

Mr. Bohe says: "Foaming is suds or, otherwise, soap."

No, foaming is not soap, but soap would cause a boiler to foam. Water containing alkali is the worst kind to foam, and that is not soap. Swamp water that contains large amounts of decayed vegetable matter will foam very badly.

I find the quickest way to stop foaming is to blow down and fill up several times a day. If anyone wants to find out all about a boiler foaming and priming, come out here and operate a steam shovel for some railroad contractor, stick your suction hose down under the roots of a tree in a swamp or dig a little sink hole in the cut and get your feed supply. Compound is not on the order sheets for a railroad contractor. Run the boiler on whatever kind of water you can reach with your suction hose. In a place like this blowing down is very necessary.

About priming, Mr. Bohe says it is caused by steam pipe to engine being too large. I always was taught the reverse. Does not a small pipe, when the valve is opened, allow the steam to flow with a greater velocity and cause a greater suction, causing water to rise and blow with steam? In a large pipe, the steam flows slowly, as it takes only a short part of the pipe to fill the steam chest and while the valve is closed, the steam flows from boiler to pipe, filling it again to the boiler pressure, causing no suction or jar as to the safety valve. If the water is high at the time of blowing off and foam forming material is present in the water, it would have a tendency to start priming.

F. M. JOHNSON.

FRANK W. BOHE has favored us with his experience and ideas on care and operation of steam boilers. I have read these letters and replies with much interest, although I do not agree with Mr. Bohe's idea of not blowing down. Still, I like to give the other fellow a fair hearing.

He stated that his boiler plant consists of 2 100-hp., 2 125-hp. and 1 150-hp. boilers; that they are in service all the time; that is, his plant is in continuous operation. He also states that he uses only 311 cu. ft of water in each boiler in 24 hr., and that he is not running them at the full capacity and would not at any cost.

Assuming 311 cu. ft. per 24 hr. feed water temperature 200 deg. F., boiler pressure 125 lb. per sq. in. gage:

Boiler horsepower developed = 571.55 in 24 hr.

Boiler horsepower developed, 23.4 per hr.

Weight of 1 cu. ft. of water at 200 deg. F.=60.07 lb.

$60.07 \times 311 = 18{,}681.77$ lb. of water per day.

Factor of equiv. evaporaton = 1.0555.

Equiv. evaporation from and at 212 deg. F. =

$18{,}681.77 \times 1.0555 = 19{,}718.6$ lb.

Boiler horsepower $= 19{,}718.6 \div 34.5 = 571.55$ hp. per 24 hr.

Horsepower per hour $= 571.55 \div 24 = 23.4$.

There must surely be some mistake in the figures given by Mr. Bohe. I can not believe that any experienced engineer would run even a 100-hp. boiler regularly 24 hr. a day developing only 23.4 hp. an hour.

I am in charge of a power house, having a boiler equipment of water-tube boilers, horizontal type; rated at 280 hp. each. These boilers are hand fired and have an 8 by 8-ft. grate. The boilers are each rated at 280 hp. and guaranteed by the builders to develop 335 hp. each. These boilers are run 24 hr. a day, week in and out, and are fed a very fair quality of water. These are blown down 2 and 3 times each 24 hr., and to judge by the color of the mud that is blown out, one would think the boilers were very dirty; but I have turbined every tube and thoroughly cleaned every interior part of one of these boilers after 1 year's service since last turbined and was myself surprised at the small amount of scale that was really in the boiler. Three boilers as above have evaporated over 500,000 lb. of water in 24 hr. without any particular difficulty, day after day, and are in A-1 condition today; have removed only 1 blistered tube from the whole battery in the last 15 months, and have no sign of removing any for some time to come.

Now I am positive that if I did not keep these boilers blown down regularly, thus removing the mud as it accumulates on the mud pan, it would overflow the mud pan and circulate into the tubes and would soon scale up the tubes, so that working these boilers regularly up to capacity and frequently over capacity would soon run me into trouble. I am a strong believer that mud is better out of a boiler; if left inside it soon becomes scale, and even if some compound is fed that successfully keeps the mud from forming into scale, then the water must get heavy with mud and a boiler full of muddy water can not be an efficient steamer.

If Mr. Bohe's figures are correct, he has a chance to get away with his scheme; but if he works his boilers at anywhere near their capacity, he will surely run into trouble unless he has a very good feed water for his boilers.

H. W. BENTON.

Boiler Tube Splitting

IN THE Sept. 1 issue, F. T. S. asks a practical question. I have had experience with tubes splitting, and also with headers in B. & W. boilers cracking while the boiler was in service. On one occasion the fourth tube on the second row split for a distance of about 18 in. The fireman had just closed the door after firing. These doors were made to swing inward, and any pressure on the inside served to close them tighter. This saved the fireman, who had not gotten away from in front of the boiler, from being burned. In this case the steam and water put the fire out as the rupture was directly over the fire. A man went up and shut the stop valve as soon as the tube burst.

In some plants this would be impossible, but in this case there was considerable room between the top of the boiler and the roof, and the roof was well ventilated, which made it possible for the man to get to the top of the boiler. The pressure was off in about 2 min. The feed was cut off and the boiler left closed up for a few hours to cool off. In the other case of tube rupture the procedure was about the same, although the tube was near the top, and the boiler was not entirely emptied. In another case 5 front headers cracked off when the boiler was being fired up after standing idle over Sunday. The pressure had been raised to about 70 lb., (150 lb. working pressure). The fire had been burning about 2 hr. The firemen noticed water dripping down in front of the fire door when he opened it to fire-up. This led to the discovery of the cracks. The fire was immediately drawn and the feed turned on. Steam was all off in a few minutes, when

the feed was shut off. No other damage was done. In another case 2 rear headers cracked after the boiler had been in operation several days. The cracks were discovered by the sizzling noise heard when passing back of the boiler. The doors were opened, and when the trouble was discovered they were quickly closed again. The fire was drawn at once and the stop valve closed. The feed was left on until there was no further danger of the boiler becoming empty.

In another plant having boilers fired by Taylor underfeed stokers, a stop valve on one of the boilers burst. It was impossible to get to the top of the other boilers on account of the steam and low head room, so that it was necessary to let the steam down on all boilers. The hose was turned into the firebox, and the fire pushed down through the dump plate into the ash pit, where more water was turned on. The feed pump was left running as long as it would run. The remaining boilers on the line did not lose very much water. They were filled up to 2 gages from the city connection, and after cutting out the disabled boiler at the header, were fired up again. The time the plant was out of operation was 2 hr.

On several occasions I have had tube cap gaskets blow out, which made it necessary to cut the boiler out at once. The fire in some cases had to be pulled out in front. If there is plenty of wet ashes or wet fine coal at hand the fire may be smothered in the furnace, but sometimes these are not at hand. The fire may be pulled out in front and the water hose turned on it. The steam arising from the hot coals will be drawn into the furnace, if the damper is left open, and aid in decreasing the heat of the fire. If there is no automatic stop and nonreturn valve on the steam line of the boiler the stop valve must be closed as soon as possible to prevent drawing the steam out of the remaining boilers on the line.

J. C. H.

Trouble With a Piston Rod

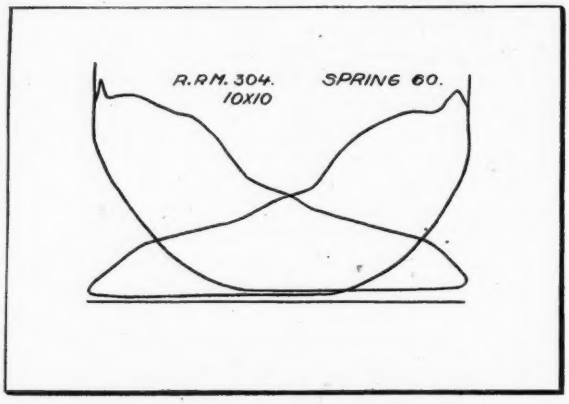
About 2 yr. ago, I sent a scored piston rod to the shop to have it turned smooth; it had been a taper fit in the piston and was held by a nut which was kept in place by a set screw that screwed into the end of the rod and nut. The hole was drilled so it was half in each, and the nut had to take the same position on the rod when the set screw was put in.

I had no trouble in removing the piston from the rod, nor in replacing it when the rod came back from the shop. The rod was turned down up to ¾ in. of the taper, so there was a shoulder here which looked large enough to hold the piston.

The engine gave no trouble for over a year, when a knock began in the cylinder, not bad but annoying. I removed the head and was surprised to see a space 3/16 in. between the piston and the nut.

I removed the piston and rod, took off the nut and tried to remove the piston; but ordinary methods failed, and as it seemed to like the rod so well, I let it stay, tightening the nut and, of course, the holes in the nut and rod were opposite and a washer had to be fitted so that the holes would match.

After adjusting the clearance, the engine ran as well as ever; but in about 3 months the knock returned, and on removing the head I found I had about 3/16 in. space as before between piston and nut. I took them out again and the piston would not move on rod even under blows from a 2-lb. hammer, so I took a piece of 2½-in. pipe 6 in. longer than the rod, set it on end and with a sledge full swing on the end of the rod, started it the fourth blow. On examining the piston it seemed all right, no signs of a crack or trouble; but the rod was upset or swelled back from the shoulder for several



CARD FROM ENGINE WHICH GAVE TROUBLE

inches and the shoulder had been forced into the piston for about ⅜ in. Why this swelled the rod and did not split the piston instead is a wonder to me, also what started the piston creeping on the rod. The engine was fitted with safety caps, so a slug of water would have broken them before damaging the engine; also, it was not overloaded. A new rod made the engine run as well as ever.

The accompanying card is from this engine taken after it was in shape.

A. O. W.

Steam Condensers for Ice Plants

On page 892 of the Sept. 1 issue, I. B. F. asks some questions regarding steam condensers operating in connection with ice plants and is answered by A. G. Solomon.

I do not agree with what Mr. Solomon has to say regarding the matter brought up by I. B. F. and beg to give some information which may be of use to the inquirer as well as to give an insight into modern ice plant engineering.

We all know that if I. B. F. has enough exhaust steam going into his condenser to give him enough distilled water to get his ice output, he will suffer, due to a shortage of exhaust steam, and therefore distilled water, if this condenser operates under a vacuum, as operating under a vacuum will decrease the steam consumption of his engines. That is one side of the matter.

The steam consumption need not necessarily be reduced, for with the same engines operating under a vacuum he can increase his power about 25 per cent and thus, by getting more power from his engines, feed more live steam into it and get the same amount of distilled water from his condenser as he is getting now.

This item is not necessary, either, for the reason that a combined surface condenser and reboiler is now being built which will take care of I. B. F.'s conditions

to very good ends. A pipe condenser is a costly outfit to keep up, especially where the circulating water is of a bad quality. They always take up more room than an ice plant can spare and are rather heavy, most of the time requiring the building on which they rest, to undergo repairs, to support them. This combined condenser and reboiler, which I have mentioned, is of the surface condenser type and is built in several different ways. Where circulating water is of good quality the ordinary type of surface condenser is used, as no trouble arises with the tubes clogging up. These machines are designed to operate with vacuum or nonvacuum.

Another design for a condenser of this type is a vertical machine which is so arranged that it can be cleaned while it is in operation. This type is designed primarily where the circulating water available is of bad quality and the tubes scale. The condensers are also arranged to operate under vacuum or nonvacuum, as desired.

An atmospheric type of condenser is by no means the best type of machine to be used in an ice plant. In a plant where a cooling tower is used and where the circulating water goes over the cooling tower first, then over the ammonia condenser and then through the steam condenser, the ordinary type of closed surface condenser can be used to very good advantage without any fear of encountering any trouble with clogging up of tubes.

In a plant where no cooling tower is used and where the water is bought from the city's mains for circulating purposes, the ordinary closed type of surface condenser is preferable. Where the circulating water is taken from a creek or a pond or a river, and is of bad quality, then the vertical open top "Clean-Type" condenser is the best. The maintenance of a machine of this sort is of no account where the maintenance of a steam pipe atmospheric condenser is considerable.

These 2 types of condensers, the standard closed type and the open type, are also designed to take care of an item which ofttimes comes up in an ice plant. Take, for instance, a 100-ton plant. The exhaust steam available gives only 80 tons of distilled water and it is desirous to have an output of 100 tons without installing additional steam engines or bleeding live steam to make up the 20 tons deficiency.

With this special condenser that I am now mentioning, it is possible to get 100 tons of distilled water when exhausting only enough exhaust steam into the condenser to give 80 tons of distilled water by bleeding 20 tons of raw water coming from the city mains. This machine condenses the steam returned to it, reboils it, taking care of the 20 tons of raw water, sending 100 tons of reboiled water a day out of the machine. This apparatus is simple, requires little attention and its upkeep is a small part of that of the atmospheric type of condenser.

In most ice plants, the reboiling apparatus takes up considerable room and gives a considerable amount of trouble. The room required by a machine of this type capable to handle a 100-ton ice plant is limited to a maximum of 4 ft. wide by 12 ft. long by approximately 10 ft. high. These machines are of 2 designs and operate under a vacuum or nonvacuum.

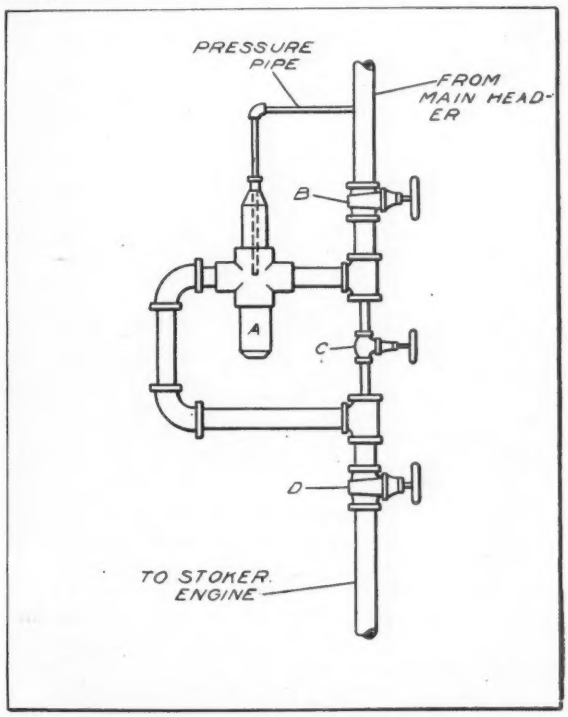
The writer has installed some of these units mentioned and seen them in operation, and can truthfully say that in every case the machines are exceeding the guarantees and expectations of the concerns that put them in.

N. Owitz,
Wheeler Condenser & Engineering Co.

Regulating Device for Stoker Engine

Herewith is a sketch and description of a regulating device used on the stoker and fan engines in the plant of the Springfield (Ill.) Gas & Electric Co. for 4 yr.

The regulator, a Mason, is placed in the steam line from main header to stoker engine, as shown in the sketch at A. B is a valve for cutting off regulator and engine; C, a bypass valve, and D, a maximum demand valve.



REGULATOR CONNECTIONS

For a given number of stokers on the line, valve C is set to allow enough steam to pass, while A is closed, to give the slowest desired speed of the engine, and valve D is set to allow the highest speed desirable. Then any sudden variation between these points is taken care of by the regulator, A.

For instance, a sudden increase in load on the generators causes pressure in the header and steam line to fall. This allows A to open and admit additional steam to the stoker engine, speeding it up, running fires faster and helping to bring up steam pressure again. As soon as pressure reaches standard again, A closes, allowing the engine to slow down.

Valves C and D must be adjusted every time a stoker is added to or taken off the line; otherwise, the regulation is automatic. As the fan engines are likewise equipped, the regulation of fires and draft is almost automatically controlled.

G. W.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Hot Pipe to Ammonia Compressor

We have 2 Vilter, 250-ton, cross-compound duplex compressors (500 ton in all), used for dry blast, to take the moisture out of the air before it enters the stoves. We get our water for the ammonia condensers out of the Rock River, which now has a temperature of 84 deg. F., giving us a head pressure of 225 lb., with the machine going 48 r.p.m., and a suction pressure of 20 lb. with the brine at 16 deg. F. The machines have a direct oil injection in the ammonia cylinder, fed by 2-pipe Rochester pumps, one oil pipe leading to the rod and the other to the ammonia cylinder. If we were to do away with the oil to the ammonia cylinder we would have our cylinder cut up in one hour, ready for reboring. The oil pipe getting hot does not hinder the working of the machines, only I wanted to know why it gets so hot. F. F.

A. This is a most peculiar and uncommon condition. Why oil has to be injected continually into a Vilter ammonia compressor, is something I cannot understand. I contend that if all other conditions are as they should be, the cylinders will get enough lubrication from the oil which is always in the system and also the oil which is drawn in on the rod.

Hundreds of the same type of compressor are running without this extra lubrication, and unless something is radically wrong yours should do the same.

The piston rings on the Vilter machine are of a different style from any other and the greatest care must be taken in setting them out to the cylinder walls. It is an easy matter to get them a little too tight. That is one way to cause excessive friction and consequent cutting.

Another trouble I have run up against is that the piston rings become so worn that the edges are like razor blades. These sharp edges will actually scrape every particle of oil from the cylinder walls and lubrication is impossible except by the means which is used in your case.

Another cause of having to use a great amount of oil is in rare cases where new bushings or new piston rings have been put in and the material has not been what it should be. For example: An upright ammonia cylinder on a Hercules machine became badly scored and as it had been bored out several times it was decided to bush it. The job was done by a local machine shop, the bushing being made of a piece of 16-in. wrought iron pipe turned to a fine driving fit and bored out smooth as glass. Cast-iron snap rings were made and their fit was also all that could be desired. Result: That cylinder was in operation just 4 days and many gallons of oil were used to prevent the groaning. At the end of the 4 days, the head was taken off and the cylinder was a sight to behold. It wasn't really scored or cut, but it was as if someone had taken a dull diamond point chisel and ripped it all over from top to bottom. That was a clear case of 2 different metals having a clinging love for each other (affinity of metals).

I have heard of the same thing happening where steel and some grades of cast iron have been brought into contact.

If it does not interfere with the economic operation, you need not worry about the oil pipe being hot, but if I were in your place I would certainly find the reason why so much oil must be used. The oil will cut down on the efficiency of the plant, as it is a good insulator when it coats the inner surfaces of your evaporating coils.

The oil pipe can only get hot from one cause and that is gas from the compressor being discharged through it. The check valve between the cylinder and oil pump must hang up or leak and allow the passage of ammonia gas at a high pressure. Just a little gas at a high pressure, forced through a small opening will cause great heat.

In regard to the sharp edges on piston rings it will be made more clear by noting the effect on a bearing of any kind if sharp edges are left when cutting oil ways. Such edges will scrape the oil off a pin or shaft and cause heating. A. G. Solomon.

Heating Swimming Pools

Have ejectors ever been used for heating water for swimming pools? Can you advise us as to capacity of different sizes of ejectors for such purpose? What pressure would be required to operate them? What quantity of water with given pressure would be heated per hour, and how much temperature rise? P. A.

A. For several years past ejectors have been built specially for this service and we understand that in most cases these work at a steam pressure of 8 to 10 lb. against a 5-ft. head, and that the heating of pool is accomplished in 7 to 9 hr. The sizes usually furnished are Nos. 6, 7 and 8—XL-96, according to size of pool, and it is our understanding that either 2 No. 7 or 2 No. 8 are installed in the valve pit at the end of pool and 1 No. 6 on the suction line of recirculating pump.

When used as heaters on low-pressure steam the capacity of ejectors will fall off slightly from that for high-pressure steam, but since local conditions such as length, diameter and sweep of pipe affect results, it would be of little use to give figures as the usual capacities given in the catalogs will approximate closely final

results. The time of heating will also depend upon the initial temperature of water as well as the final temperature desired, and as none of these governing factors are given, we supply the general information given above, which we have gathered from pools where these ejectors are in operation. PENBERTHY INJECTOR CO.

Engine, Boiler and Pump Questions*

WHAT PARTS of an engine must have the most attention to get the most economy out of the steam?

7. Give reason for adding a condenser to an engine.

8. What is the difference between submerged tubes and plain vertical boiler tubes?

9. What does the Ohio standard require in regard to boilers carrying 135 lb. of steam?

10. If your safety valve was set at 200 lb., and the inspector came around and told you to set for 160 lb., and after doing so you get 10 lb. blow-back, what would you do?

11. What does the Ohio standard require in regard to the connection of water columns? What effect has too little and too much lost motion on pump?

12. What is meant by the slip of a pump?

13. Under what conditions can a pump be placed to lift water 30 ft.?

14. What does the Ohio standard require on discharge line between boiler and pump?

15. In installing a new engine, what kind of device would you select for internal lubrication?

16. Why are 2 eccentrics placed on a Corliss engine?

17. How should pipe incline, toward engine or boiler?

18. What determines the displacement of an engine?

19. Give 5 advantages the 4-valve engine has over the common slide-valve.

20. What determines the length of steam ports?

21. How much water will an 8 by 10-in. pump handle running 100 r.p.m.?

22. How would you prepare a boiler for cleaning and inspection when one of a battery under pressure?

23. Why is it good practice to clean fires quickly?

24. Which has the greater strain on boilers, the steam pressure or the changing temperature of the furnace?

25. What is a vacuum breaker? Where is it used and what for? C. H.

A. Economy of an engine depends upon the manner in which the steam is handled by the valve, or valves, and their condition. It is an easy matter for the valves or piston to leak a small quantity of steam at every stroke, which though small, will in the long run amount to considerable fuel. It is also a comparatively easy matter to test out for leaks, which should be done often.

7. The reason for adding a condenser to an engine is primarily to reduce the steam consumption, as a vacuum of 26 in. of mercury applied to a noncondensing engine is equivalent to a gain of approximately 12 lb. mean effective pressure, which is subtracted from the total m.e.p. and the fractional part of the total that this 12 lb. is, is the approximate amount of saving in steam, due to the use of a condenser.

8. In a plain vertical tubular boiler, the top tube sheet is flush with the top of the boiler shell, and as the water line is carried from 12 to 36 in. or more below the top of the boiler, the tubes will project the same amount above the water in the boiler. In a submerged tube boiler, the top tube sheet is depressed in the center of an area equal to the area of the tubes and adjoining ligaments, so as to bring this depression below the bottom of the gage glass. In this way, the tops of the tubes are always covered with water under ordinary operating conditions, and as this type of boiler is used more in small tug boats than in any other service, this design prevents splashing of the water in the boiler in a rough sea, also excessive priming.

9. The Ohio standard requires that all boilers carrying more than 135 lb. of steam pressure, shall have all attached valves, fittings and pipes, extra heavy. Bottom blowoff valves, or valve and cock, shall be 2 in number, and the plug of the cock shall not be fastened with a nut. No globe valve will be allowed on a bottom blowoff connection. The steam valves shall be outside screw and yoke type, and if boiler has a manhole, there must be 2 valves with open drain between them. A nonreturn valve with outside screw and yoke, will be considered equal to a stop valve. No blowoff pipe shall be smaller than 1 in. nor larger than 2½ in.

10. After an inspector has reduced the pressure at which a safety valve should relieve, it should not be changed so as to increase that pressure, and if it is found that under the new conditions, the blow-back is 10 lb., the device provided in the valve for that purpose should be adjusted so as to reduce the blow-back to about 2 or 3 lb.

11. For boilers carrying 25 lb. pressure and under, there will be at least one water glass, the lowest visible part of which shall be above the fusible plug or safe water line. Also 2 or more gage cocks located within the visible range of the water glass. If 2 water glasses are used, not less than 3 ft. apart in the same horizontal line, gage cocks are not compulsory. For boilers carrying to exceed 25 lb. pressure, the same rule holds good, except that 3 gage cocks are required within the visible range of the glass. Water column connections to any boiler shall not be less than 1 in., and all pipes, fittings and valves must be extra heavy. Tees and crosses plugged with brass plugs as required, will be used in place of elbows on the water connection, steam connection to be taken from the top of shell or head, of a tubular boiler, and the water connection from a point not less than 6 in. below the center of the shell. No connections to the water column pipes allowed except those for steam gages, damper or feed water regulators, or for drains, and if valves are used in connections to shut column off from the boiler, these valves must be of the straightway type, outside screw and yoke, and shall be locked or sealed open.

It is necessary to have a certain amount of lost motion in the valve stem connections to a steam pump. As the amount of lost motion is increased, the length of the stroke is increased. If it be decreased the stroke is decreased. When pumps leave the shop, they are properly adjusted, but through wear or error in adjustment, they are liable to require attention sooner or later.

*Continued from page 937, Sept. 15 issue.

12. The "slip" of a pump is the difference between the actual displacement of the plungers at any given speed, and the amount of water pumped. If a 6 by 4 by 6-in. duplex pump operates 100 r.p.m., the actual displacement of the plungers in cubic inches will be: $(4 \times 4) \times 0.7854 \times 0.5$ ft. $\times 4$ (strokes per revolution) $\times 100$ r.p.m., which equals 30,000 cu. in. theoretical displacement.

Suppose, however, that the water actually pumped is found to be but 103 gal. Then:

103×231 (cu. in. in a gal.) gives 24,000 cu. in.

This leaves 6000 cu. in. as the "slip," or in this case, about 20 per cent. Slippage is a varying quantity, as it differs greatly with different pumps and different services, sometimes running up higher and again being entirely absent. As a matter of fact, under certain conditions, the slip may be negative; that is, the water will continue to pass through the valves of the pump after the plunger has come to rest, and if the valves be in good condition this gain will be quite noticeable.

13. As the reading of the barometer under a given atmospheric condition decreases from 14.7 lb. at the sea level as we rise above it, so will it increase as we descend below the sea level. Careful experiments made with deep mine shafts disclose the fact that the reading of the barometer increases 1 in. with every 900 ft. of descent.

If a mine pump were to be located at the bottom of a shaft, say, 4500 ft. below the sea level (of which there are a few), a barometer reading of 35 in. of mercury would be secured and under these conditions a well kept pump would raise water from a level 30 ft. below it.

14. On boilers of more than 50 hp. capacity, requiring some mechanical device to supply the water, 2 such methods or more must be provided. Means must be provided to supply a boiler with water against the maximum pressure that it will carry. Every feed pipe must have a check valve with a valve or cock between it and the boiler. If a globe or angle valve be used, the inlet shall be under the disc of the valve. Boilers of 50 hp. or over, set in battery, shall each have a stop valve or cock, on each side of the check valve.

15. To supply the internal lubricant to an engine, use either some reliable form of pump operated by some convenient reciprocating part of the engine, or a good sight-feed lubricator. The latter may have the reservoir and sight-feed and gage glasses combined in one instrument or a sight-feed glass can be installed at the proper place on the steam pipe in lieu of the combined instrument, and the supply lead to it from a large reservoir located conveniently and supplied with a gravity pipe from the steam main that will insure continuous feeding of the oil. It is also good practice to have a hand oil pump for emergencies.

16. When but one eccentric is placed on an engine, the angle of advance of the eccentric is such that it is passing its center at or before the time the piston is at ½ stroke. This limits the cutoff to this point or less. When 2 eccentrics are used, the one handling the exhaust valves has approximately the same relative position to the crankpin, as has the eccentric on a single eccentric engine; but the eccentric handling the steam valves has a very small angle of advance so that by the time it is passing its center, the piston may have traveled 75 to 80 per cent of the stroke. This insures regulation at excessive peak loads, and also permits more flexibility in setting the valves, as under the single eccentric, ideal conditions are the exception rather than the rule, sacrifices having to be made in the interests of a good general average in the steam distribution.

17. As a general rule, to which there are but few exceptions, the steam pipes leading from the boiler to the engine should incline toward the latter so as to have both the steam and the condensate traveling in the same direction; otherwise, there is always a possibility of water being held in partial suspension some place in the pipe under ordinary running conditions; but when a sudden load causes an increase in the velocity of the steam through the pipe, it will take along the slug of water to the engine, where it may do some damage other than reducing the cylinder temperature and increasing the condensation.

Unless the steam pipe be exceptionally short and taken from the top of a well drained header, there should be a good separator on the steam line close to every engine cylinder, and well trapped.

18. Displacement of an engine is the cubical contents swept through by the piston during 1 stroke, and is the product of the piston area times the stroke in any given dimension. Unless the displacement be small, as with a small engine, it is generally referred to in cubic feet.

19. 1. Higher initial pressure.
2. Variable cutoff.
3. Greater number of expansions.
4. Lower terminal pressure.
5. Lower frictional losses in valves.

20. Steam ports of an engine cylinder are subject to perhaps more differences of opinion than any other part. The area ranges all the way from 1/16 to 1/10 of the piston area, depending on piston speed and steam pressures. For most conditions, a port area of 1/14 the piston area, is used. This provides an opening ample for rapid admission of the steam, while an exhaust port area of about ⅛ the piston area provides an opening ample for the passage of the exhaust steam without back pressure.

With the advent of the high-speed automatic slide-valve engines, it was found good practice to make the ports long and narrow so as to have a short valve travel, on account of the valve being handled by the shaft governor. Most of these engines have steam ports longer than the diameter of the cylinder and many much longer, so that cylinder condensation will drain naturally with the flow of the steam into the exhaust port as well as back into the chest when idle, and there drained.

On Corliss engines the steam ports are as long, or longer than the cylinder diameter, and double porting being almost universal now, this gives a long admission edge which insures the highest possible initial pressure without wire drawing.

21. This question cannot be answered on account of lack of data. To find the amount of water any pump will handle, multiply the area of the plunger by the stroke and by the number of strokes per revolution. If the dimensions are in inches, dividing by 231 will give the answer in gallons. Multiply this by the number of

revolutions per minute, and the answer will be the theoretical amount of water pumped per minute. Make allowance for slip if necessary.

22. The following method should be used if the boiler can be spared long enough. Allow the fire to die naturally, with the doors closed and damper open slightly. Let it remain for several hours before closing the stop valves connecting the boiler to the header. If automatic valve is used, it will close as soon as the pressure begins to drop. Let the boiler remain about 24 hr. after pressure is off, and then empty. Open the manholes or a few handholes so as to create a little circulation through the boiler. See that all stop valves are locked or sealed to prevent opening while the man is in the boiler. Wash the boiler with good pressure and preferably with water at about 125 deg. Get inside and take whatever steps are necessary to remove scale, mud, etc., and it is a good idea to put a wooden plug in the blowoff pipe inside the boiler to prevent it from becoming clogged with scale.

When all scale is off that can be taken off, remove through the manholes or handholes as is convenient, and take out the wooden plug. Wash thoroughly again. Clean the grates, and all parts of the boiler outside that can be reached, by whatever means is necessary. Clean out the combustion chamber or other places where soot and ashes lodge. Inspect the brick work inside and out and make whatever repairs are necessary. Don't forget the water column connections. They might be full of scale. If your boiler is clean inside and out, it goes a long way with the inspector. Do not open fire doors and allow a boiler to cool too quickly if it can be avoided.

23. First, to prevent the entrance of cold air, which cools the boiler rapidly, and causes strains on it.

Second, to prevent too much drop in the steam pressure.

24. In a boiler where the circulation is fair, the temperature of all parts is nearly uniform. Any change in the steam pressure (and consequently, the steam temperature) changes temperatures but a few degrees. Dropping the steam pressure from 150 to 100 lb. changes the temperature only 27 deg. Changes of several hundred degrees in the temperature of the furnace are liable to take place within a short time, from causes such as opening the fire door, or allowing a hole to burn through in the fire. These set up strains in boilers, as all engineers can testify who have had leaky tubes and rivets if, indeed, they are fortunate enough to have nothing worse.

25. A vacuum breaker is an automatic valve (usually) located in the connection between the engine exhaust and the condenser, for the purpose of destroying the vacuum. As the chance for water to back up into an engine cylinder from a surface condenser is quite remote, a breaker is generally confined to jet condensers. In a general way, it consists of a valve controlled by a float which in ordinary operation is free of the water and the valve is thus closed. But if, for any reason, the water rises in the condenser so as to jeopardize the engine, the float rising on the water opens the valve and destroys the vacuum. Frequently a hand valve is located conveniently from the operating floor for the purpose of breaking the vacuum when shutting down.

G. H. WALLACE.

Catechism of the Corliss Engine*

IF ONE steam radial rod broke, could the engine finish its run?

A. Yes, providing the load was not too heavy. In a case of this kind, the engine would run one-ended, the broken side not picking up.

19. If an exhaust radial rod broke, could the engine be kept in service?

A. Yes, by blocking the disabled exhaust valve open. This would be, of course, very uneconomical, as the live steam would blow through the cylinder without doing any work.

20. What would be the best way to run if one exhaust valve went out of service?

A. Disconnect a steam valve and run one-ended.

21. Would it be possible to run an engine with one end condensing and the other noncondensing?

A. Yes.

22. If a Corliss engine has run a long time, why would it not be advisable to lengthen the exhaust radial rods?

A. The seat of the exhaust valve may be worn, or shoulders may be formed.

23. What harm would this do?

A. The shoulders would cause leakage of steam, and a disagreeable knock.

24. In designing Corliss engines, it is considered good practice to have short valve arms. Why is this?

A. The shorter the arm, the less will be the eccentric throw for a given valve travel.

25. What is the "range of cutoff" in a single eccentric engine?

A. About half stroke.

26. What is meant by "range of cutoff?"

A. The "range of cutoff" may be considered as that part of the stroke or piston travel in which the steam may be supplied to the cylinder.

27. How may the "range of cutoff" be increased over half stroke?

A. By adding an eccentric and wristplate to the engine valve gear, thus operating the exhaust valves and the steam valves separately.

28. Explain how the eccentric travel limits the "range of cutoff."

A. With the valves properly set, the engine to run over, the crank on the head end center, and the head end steam valve opening for lead, the eccentric will be ahead of the crank 90 deg. plus the lap of the steam valve and the lead. Now, as the crank moves toward the up quarter, the eccentric, through its connections, pulls the wristplate towards the crank end of the cylinder, opening the head end steam valve, the crank end exhaust valve. But if we think now, we can easily see that before the crank reaches its up quarter, the eccentric will have reached its extreme of travel, and it will now begin to move the wristplate toward the head end of the cylinder, and if the valve has not been released, it will be closed positively, as the trip block is moving away from the hook. Thus, the cutoff must take place while the crank is traveling from the center to the quarter, or half stroke.

A. D. PALMER.

(To be continued.)

*Continued from page 937, Sept. 15 issue.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Changing Gas Engine to Air Compressor

COULD SOME of the readers of Practical Engineer tell me how to convert a 1½-hp. gas engine to an air compressor? Could I use the present intake valve? If not, what kind of a valve should I use? L. P. M.

Corliss Engine Cards

THESE CARDS were taken on a Lane and Bodley Corliss engine. Will you please advise me what further changes I can make? H. E. S.

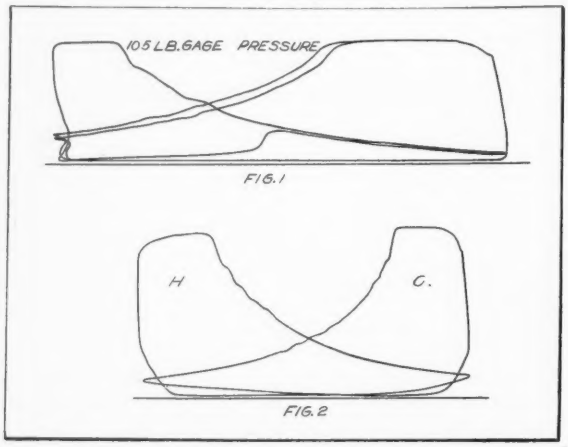


FIG. 1. CARD TAKEN BEFORE THE VALVES WERE ADJUSTED
FIG. 2. CARD TAKEN AFTER ADJUSTING THE VALVES

Compressor Trouble

IN ANSWER to L. E. M. in issue of Sept. 1, 1914, his machines are running at pressures that will give him the best efficiency. The compressor discharge will run hot, corresponding with the pressure, which he says is 190 lb. gage pressure. Some tables give the temperature of ammonia at that pressure as 97 deg. F. (Absolute temperature, 557 deg. F.) To lower the temperature of the ammonia leaving the compressor, we must lower the condenser pressure by supplying more water to the condenser or make the supply of water colder; but, in doing that, we are cutting down the efficiency of the compressor, so losing a certain amount of refrigeration capacity. There is nothing gained by freezing back to the machine, as it affects the temperature of different parts of the machine, piston rod packing, etc., and will cause leaks.

If it is a dry compression machine, let your ammonia come back to the machine as cold as you can without frosting. If you have a wet compression machine, it is a different proposition. I would not advise anyone to run wet on a dry compression machine, as the clearance at each end of the stroke is too small to take care of a dose of liquid ammonia, therefore it is dangerous.

In a wet compression machine or a machine with large valves and plenty of clearance, you could run at 40 lb. suction and 100 lb. condenser pressure; that would give you a much colder discharge from compressor, but you would not benefit any except in the amount of water used on the condenser. J. S. BELL.

An Unexplained Accident

IN THE article on a ruptured pipe line, Aug. 15 issue, E. M. wants to know whether or not the accident could have been avoided with extra heavy pipe.

With the operation as stated, it could not, as standard pipe is pronounced safe; however, when the erector is buying pipe to be used for such pressure, he should buy extra heavy, or double strength pipe.

Opening valve F to draw the water out of lines C and G, would not have prevented the rupture, as opening valve F would have disturbed the water in line G and caused water hammer.

The trapping of the engine is certainly all right, but while the engine was being repaired, there should have been a ½-in. bleeder as close up to valve E as possible, which would have taken care of the condensation. If there had been a dozen traps on valve F, that would not have prevented line G from filling with water.

It is likely that valve E was opened too wide with the very sudden rush of steam in what had been a dead line causing very sudden expansion on a cold line, thus causing the rupture. H. A.

I HAVE never taken any part in published discussions because they are usually a source of unending opinions and what one engineer might think was good engineering another would think the opposite and both might be reasonably right; on the local conditions of an installation no outsider should criticize without knowing the underlying reasons why certain machinery or pipes were installed in the methods in which they are many times.

I would regret to know that I had any such connection in my plant as E. M.'s sketch shows, because, in my judgment, it is dangerous in the extreme. If it was necessary to drop pipe C, then valve E should have been planted on the tee B in order to shut off the entire line down to the engine, and if there had been a bleeder at the engine, no water could have collected in this line at any point. I would never make a drop

connection from the main line if it were possible to take a branch off the top with a stop valve planted, as I said before, directly on the tee with the line properly graded and drained to the engine with a drip valve that could be left wide open as long as valve E stayed tight, and this method would not require a trap.

With the cut as shown, I question whether the bleeder F had been opened before the valve E was opened, even that would have saved the water ram and it is quite evident that that is what occurred when the attendant started to open valve E.

Again, if it was necessary to install a pipe as shown, the bleeder valve F should have been installed close to valve E and connected to a trap that would keep the line drained at all times; but the surer way to keep the line drained would be to connect this bleeder line to a house pump or feed pump that had to run continuously, and this method would save the cost of a steam trap and one would always have a positive indication whether the line was properly drained or not.

In regard to the pipe and fittings themselves carrying from 180 to 190 lb. pressure, common prudence would have suggested at least that the pipe should have been full weight, standard wrought iron pipe with extra heavy fittings as a minimum for constant service; but I question if extra heavy pipe would have withstood the blow that, indications signify, occurred when that water ram started. If the pipe installed was below the standard weight, it simply let go so much easier.

As I said in the beginning, the whole trouble could have been saved and the life as well, had the valve been planted on the main line tee, where it belongs, when the original work was installed in order to keep the entire branch line drained when out of commission.

A. S. VINCENT.

REGARDING THE pipe accident described by E. M., I think, from the layout of the piping and the manner in which the valve was opened, that the accident was due to carelessness, but not on the part of the man who operated the valve. At the time the 5-in. valve was opened, the pipe was probably full of water.

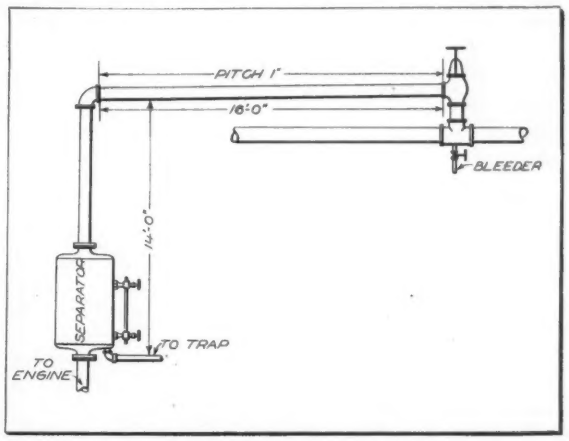
In the first place, the bleeder valve is not properly installed. If the 16-ft. 5-in. pipe is level, or grades towards the engine as it should, there would be considerable water in the 5-in. line that could not be drained out by the bleeder as arranged in the sketch.

E. M. states that the tee in the 10-in. line is about 100 ft. from the boilers. There would be considerable condensation in that length of pipe which would drain into the 5-in. line taken from the bottom of the header. This in itself is very bad practice. The 10-in. tee should be turned over and the branch taken from the top. The bleeder would then have been taken from the bottom of the 10-in. tee. As the pipe is now arranged, the bleeder should be tapped into the bottom of the 5-in. line near the valve, about where the pipe ruptured.

In the ordinary 5-in. gate valve, there is considerable clearance in the threads on the stem in the valve, and, when the valve is opened, it is hard to operate it as slowly as with a globe valve. The piping being full of water when the valve was "cracked," the rush of steam into the cold pipe caused a violent water hammer which ruptured the pipe. It is also stated that the pipe was 1/32 in. under the thickness of standard pipe. For a pressure of 190 lb. extra heavy pipe and fittings should be used especially in the main steam line on account of vibration and liability to water hammer.

The piping system should be so arranged that there is no possibility of water hammer occurring, even though an inexperienced man is allowed to operate the valves.

It has been proven that a violent water hammer may exert a pressure of several hundred pounds per square inch in a pipe, and even extra heavy pipe and fittings are liable to rupture.



PROPER CONNECTION TO HEADER

E. M. states that the 5-in. valve is 16 ft. from the header, and that the branch drops 14 ft. to the engine, which is properly dripped and trapped. The enclosed sketch shows how, to my mind, the piping should have been installed, and pipe and fittings designed for 250 lb. working pressure should have been used.

The 5-in. valve should be at the header which would prevent the pipe filling with water. This arrangement would require less fittings, have less joints to give trouble, water hammer would be less likely, and the chance of accident greatly reduced. J. C. HAWKINS.

Buckeye Engine Diagram

THE BUCKEYE engine diagram, published on page 892, Sept. 1 issue, shows admission and release late on both ends, although slightly more on one end than the other. This difference can be corrected by changing the length of the main valve stem; then admission and release on both ends will be late an equal amount; to correct this, shift the main valve eccentric ahead on the shaft, say 1/8 in. or more if necessary to make these wants occur on time; from the diagram I think 1/8 in. will be enough. The diagrams are fair and there are lots of engines a whole lot worse, yet the alterations noted above will correct what small defects at present exist.

H. W. BENTON.

FULLER'S EARTH generally is recommended for clutches that slip when they ought to grip, but something that is nearly as desirable, and much easier to apply, is glycerin. It can be poured on the leather out of the bottle, and if there is any tendency for the clutch to grip too suddenly, a little graphite can be added to the glycerin. —Gas Energy.

PRACTICAL
ENGINEER

Trade-mark reg. U. S. Pat. Office.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH
At 537 So. Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.
New York, 150 Nassau St.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Copyrighted, 1914, by Technical Publishing Co.
Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500.

CONTENTS

Power and Light for Olean. Illustrated 955
An Air Lift Engineering Feat. By Frank Richards. Illustrated 959
Bureau of Mines' Exhibit at Panama-Pacific Exposition 960
Speed Governing for Unusual Requirements. By Sterling H. Bunnell 961
Blowoffs for Boilers. By Receiver Illustrated 962
Slide Valve Setting with a "Dummy." By Carleton A. Read. Illustrated 963
Separation of Oil from Condensed Steam. By W. T. Wardale. Illustrated 964
Locating Direct-Current Armature Faults. By Gordon Fox. Illustrated 965
Power Costs in Central Stations 967
New Steam Turbo-Generator Installation. By L. R. W. Allison. Illustrated 969
Public Service Electric Rates. By Henry D. Jackson 969
Jeremiah Judson, C. E. Illustrated 971
A System of Daily Elevator Inspection. By C. E. Anderson. Illustrated 973
Water Line of Threaded Pipe. By H. L. Sherman. Illustrated 974
Burning Lignite 975
Letters Direct from the Plant: Directions for Safety Valves. Minnesota Examinations. Operating Taylor Stokers. Selecting a Flywheel. Retubing Boilers. Blowing Down Boilers. Boiler Tubes Splitting. Trouble with a Piston Rod. Steam Condensers for Ice Plants. Regulating Device for Stoker Engine. Illustrated 976
Questions Answered and for Answer: Hot Pipe to Ammonia Compressor. Heating Swimming Pools. Engine, Boiler and Pump Questions. Catechism of the Corliss Engine 982
Problems for Discussion by Readers: Changing Gas Engine to Air Compressor. Corliss Engine Cards. Compressor Trouble. Unexplained Accident. Buckeye Engine Diagram. Illustrated 986
Editorial: Power Plant Development 988
In the Midst of Milwaukee. Illustrated 989
A Wanderer's Impressions of the Exhibit 994
Kebec Circulator for Boiler Water. Illustrated 998
Control of Motors Operating on Pressure Systems. Illustrated 1003
Little Tugger Hoist. Illustrated 1003
News Notes 1004
Books and Catalogs 1004
Trade Notes 1006

Power Plant Development

Progress in any mechanical industry is largely through the development of details. It is only rarely that somebody discovers a new principle which changes processes or revolutionizes machinery. In the power plant we have a notable example of the value of improvements in details. In the generation and use of steam there has been during the past 20 yr. but 2 revolutionary changes in equipment, and even these are not universal, we refer to steam turbines and mechanical stokers, yet the overall efficiency of a modern plant has increased greatly. This result is due to improvements in details and methods.

Who can estimate the saving due to the use of modern rod packing, or continuous lubrication now common on engines? It is along lines of details, then, that we may look for further development and the men who will most likely effect improvements will be specialists in their lines.

At the recent exhibit in Milwaukee we were impressed, not only by the number of firms that are in the business of manufacturing specialties, but with the fact that almost without exception their products have undergone changes in design, making them more reliable, simple and economical. Nearly every factory has its experimental department which is continually at work studying defects and how they may be remedied.

Here is where the engineer or any other man about a plant may exercise his ingenuity and inventive ability as well as help to increase power plant efficiency. If a piece of apparatus fails to perform its work as well as expected, the man who has charge of it usually has an opportunity to study its action, the fault is generally in the adjustment, but occasionally due to bad design. A letter to the manufacturer explaining the difficulty and suggesting a remedy would be highly appreciated and may cause experiments which will result in a redesign. Many improvements are not patentable, and can be applied only to a single type of apparatus, so if a man makes a discovery which he cannot put to best advantage himself he owes it to his profession to make his discovery known to those who can use it.

There is scarcely a power plant that is kept in good shape that does not have some contrivance, or system or method which has been devised by some member of the organization that works admirably and yet will not be found anywhere else. The devices you see are often crude and would admit of improvement, but lack of facilities prevents. If some manufacturer was made acquainted with the device his experimental department could bring it up to a high state of perfection.

As an indication that manufacturers are eager for such information, there is scarcely an article published in Practical Engineer relating to improvements to or experiments with a manufactured article that is not the subject of a letter from some manufacturer commenting upon the article. Without question efficiency in the operation of a power plant is due to the efforts of operating engineers, but the development of efficient apparatus must be credited to the manufacturer.

In the Midst of Milwaukee

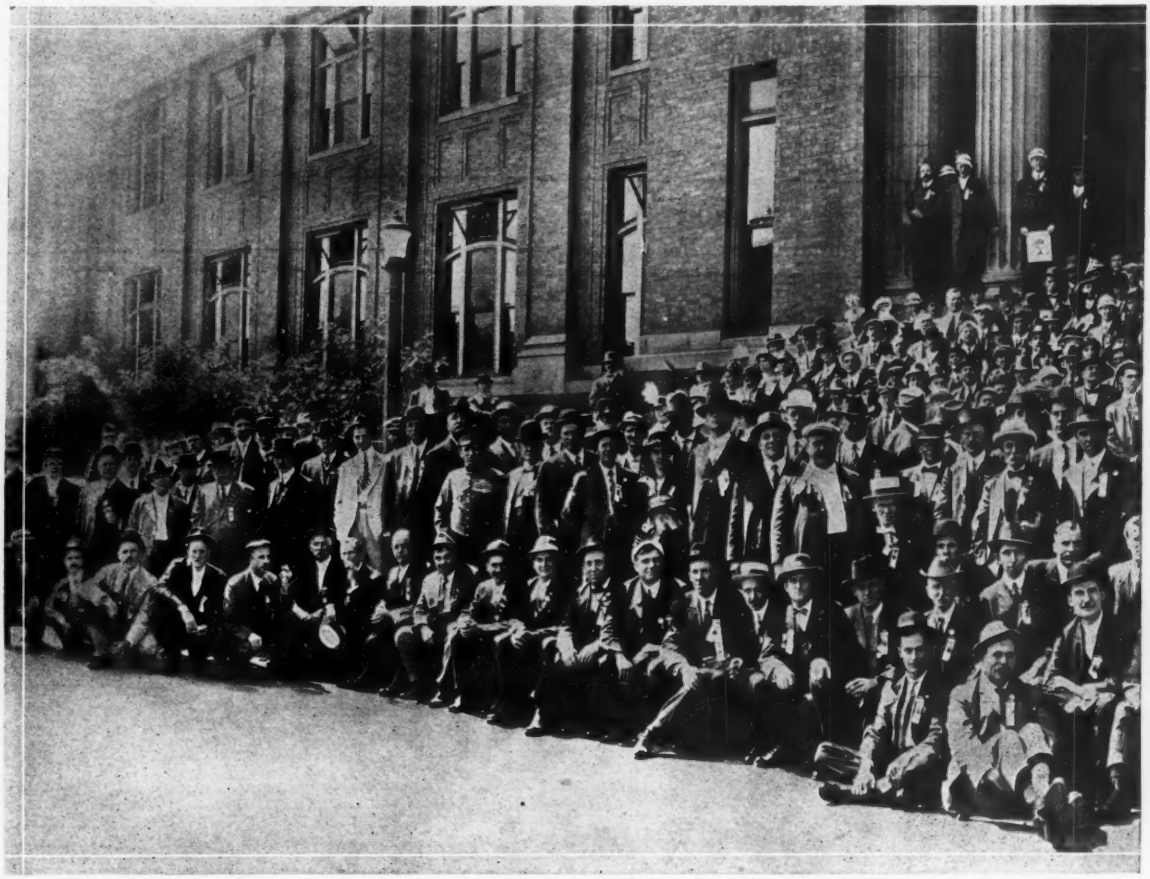
THIRTY-SECOND ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS HELD AT MILWAUKEE, WIS., SEPT. 7-12

OTHER things may have made Milwaukee famous but it cannot be denied that to a great extent the hospitality of her citizens is at present instrumental in giving her a good reputation. If you doubt this, ask any one of the thousands of engineers who entered the portals of the Cream City to attend the annual convention.

It was immaterial what the hour may have been, if you came by rail, water, or afoot, a big brass band was there to meet you and made you feel just as if you were wanted. It was a thrill experienced but seldom in a lifetime; and what was still better was that that great big brass band would not even let you walk to your hotel alone for fear you might become lost or kidnapped. Such was our reception to Milwaukee.

After a much-needed rest, we cleaned up, had supper and walked up Grand Ave. to Fifth St., and north 2 blocks to the Auditorium, where at 8 o'clock, the official opening of the mechanical exposition took place and in which building all convention meetings were held.

It seemed like going back to your old-home town when walking up and down the broad aisles of the exposition hall you would meet the old boys and could stop to chat for a moment or to comment upon the splendid exhibits or recall the good times had at former conventions.



GROUP OF ENGINEERS, SUPPLY MEN AND FRIENDS AT MILWAUKEE CONVENTION

OFFICIAL OPENING

IT WAS about 10:30 Tuesday morning that the steam was turned on and the big wheels were set in motion, with an attendance of nearly 1000. The assemblage was called to order by John A. Wickert, chairman of the local convention committee, who in his brief talk, reviewed the efforts required to bring the convention to Milwaukee and compared it with those held there in 1888 and 1900. Following Mr. Wickert's talk, the invocation was offered by the Rev. Dorward, after which Governor McGovern was presented.

He spoke on the evolution of the steam engine and in his concluding remarks referred to the Wisconsin workman's compensation law and voiced his opinion as heartily in favor of the enactment of a state law for the licensing of engineers and the inspection of steam boilers.

National President Coe responded to this by thanking the governor for his words of welcome to the state and briefly outlined the aims of the N. A. S. E.

Mayor Gerhard Bading then told of the city's resources, its industries, its parks and recreation features and above all the strong yet well-balanced and orderly spirit of personal liberty so prevalent there. He expressed belief that the licensing of engineers should be a state function and not that of a city.

Response to the mayor was made by National Vice President Ray, which was followed by a short talk by Wm. George Bruce, secretary of the Merchants' and Manufacturers' Association.

The preliminary report of the credential committee showed an attendance of 382 delegates.

Reports of the National president, national deputy, license and educational committee were referred to the proper committees, and at 3:10, the convention adjourned, after which a large party of delegates and guests paid a visit to the Schlitz brewery. It was stated before leaving that this visit was for the purpose of inspecting the ice plant of the brewery; but from all reports which afterwards gained circulation, it would seem as if this was not the only reason. Why didn't the boys visit Luicks, one of Milwaukee's largest ice cream factories instead?

GROUP OF ENGINEERS, SUPPLY MEN AND FRIENDS AT MILWAUKEE CONVENTION

Mr. Bruce's talk was responded to by Past National President McGrath, who stated that the visitors had come well prepared for all the good things Milwaukee held in abundance, for many had had experience on former and well-remembered occasions and the rest had been plentifully informed. He stated that Milwaukee was a fine example of the evolution of a frontier trading post into a splendidly arranged and conducted city.

Chairman Wickert then presented President Coe with a silver-handled gavel, whereupon the latter assumed the chair and announced the committee appointments.

Tuesday afternoon's session convened at 1:45 o'clock and was devoted to the presentation of official reports.

The ladies were not left out of consideration, for at 8:30, all members of the fair sex were entertained at a card party in one of the adjoining halls. And at 10 o'clock, the band which had been rendering selections throughout the evening on the stage of the exhibit hall, marched up and down the aisles and picked up the boys to take them over to the smoker, which was given under the auspices of the National Exhibitors' Association. Both of these functions were well attended and greatly enjoyed by all present.

Wednesday, September 9

My, but it was hard to get up in time to make that 9:30 session after having had such a good time the night

before! In spite of the fact that we had not retired until sometime after midnight, we did manage to arrive at the hall by 9:27—3 min. ahead of time.

Just as we entered the hall, President Coe took the chair and as we were seating ourselves, he called the meeting to order. Before bringing up of the regular business, invitations to visit the plants of the Cutler-Hammer Co. and other manufacturers were read.

In an address on legislative matters, Chas. H. Wirmel, chairman of the national license committee, stated that as many of the state legislatures would be in session the next winter, he deemed it advisable that all who contemplated introducing bills should perfect their campaign arrangements at the earliest possible time so that they might be handled expeditiously and efficiently. The needed legislation included engineers' licenses, boiler inspection, compensation laws for the hazardous occupations, and general welfare measures.

John T. Monk of Buffalo, New York, explained the circumstances of the recent attack on the license ordinance of that city. The ordinance prescribed a 1 yr. residence before an applicant would be examined or given a license. Frank R. Williams of Syracuse, brought action in the U. S. district court to set aside the ordinance on the ground that the 1 yr. residence clause was in contravention of the federal constitution whereby no citizen may be unfairly discriminated against. In deciding the case at issue Judge Hazel ruled that the city had no power to refuse to examine an applicant because he was not a resident of the city, and upheld the contention of Williams, citing the fourteenth amendment to the federal constitution. The portion of Williams' plea charging conspiracy by the engineers' associations and the local examiner of engineers was dismissed for lack of evidence.

The next order of business was the presentation of altar flags to the associations which had gained 10 or more members during the past year, the delegate from each of those associations being given the trophy to carry back home.

GROUP OF ENGINEERS, SUPPLY MEN AND FRIENDS AT MILWAUKEE CONVENTION

In presenting the flags President Coe said he hoped that the winners would be inspired to still greater efforts during the next year.

Immediately after this session the delegates, visitors and exhibitors hurried over to the Public Service building and boarded special cars which took them to the West Allis Works of the Allis-Chalmers Mfg. Co. The more fortunate ones being carried in automobiles.

Upon arriving at the works we were met by a delegation of the company's representatives who took us to the club house, where an elaborate luncheon was served.

We were then escorted by numerous guides through the works, where engines, turbines, and other power plant apparatus were shown in all stages of construction. A feature in which all appeared to take considerable in-

terest was the new Diesel type of oil engine which this company now manufactures and which burns crude oil or any of its distillates. A number of these machines were in process of manufacture, giving us a good opportunity to see the "insides."

At 8 o'clock in the evening a band concert was held in the exposition hall, which was well attended by not only delegates and visiting engineers but also by hundreds of Milwaukee citizens.

This was our first opportunity since Monday to call at the booths and become acquainted with the newest power plant accessories and collect our share of souvenirs, booklets, etc., and a goodly share we did collect.

THURSDAY, SEPTEMBER 10

THE MORNING session convened at 9:50 o'clock with President Coe in the chair.

Final report of the credential committee showed 411 delegates in attendance, and the mileage committee reported the total miles traveled by the delegates as 311,648, which at 5 cents a mile called for an expenditure of $15,582.40. This money was paid to the delegates Friday afternoon.

FREDERICK L. RAY, NEW PRESIDENT N. A. S. E.

After the report of the board of trustees of The National Engineer, and a rising vote of thanks to its members, Judson Pratt of Cincinnati introduced a resolution whereby the National Association of Stationary Engineers indorses the action taken by the American Society of Mechanical Engineers tending toward the perfection of the standardization of laws pertaining to the construction and operation of steam boilers and that a representative be appointed by the National President to attend any conference of the American Society for the purpose of keeping in touch with its action and to assure it that the N. A. S. E. is in full sympathy and accord with any such action.

The committee on referendum presented proposals to amend the constitution as submitted by subordinate associations, which in brief included the following:

1. To make the closing session of the convention executive.

WALTER H. DAMON, NEWLY ELECTED VICE PRESIDENT OF THE N. A. S. E.

2. Applicants for membership must have declared their intention to become citizens of the United States.

3. No business shall be transacted by the convention after the election of officers, except the installation of the latter.

4. To pay the money collected as per capita tax into the pension fund.

5. To create an affiliate membership for competent engineers who reside in places where there is no association, upon payment of $2 a yr. to the national secretary. Such members shall have the privilege of attending association meetings, but shall not have a vote.

The following recommendations of the president were acted upon favorably:

To submit the matter of affiliate membership to a referendum vote. To insure the slides and other property in the custody of the educational committee and advisory board. To continue the present system of bonding money funds in bank.

The recommendation of the national deputy that a committee of 3 be appointed to devise a system of re-

ports so that the associations may submit a correct report to the state deputies, and the latter to the national deputy, was adopted.

The convention approved of the recommendations of the board of trustees regarding the establishment of a book department, and the paying of a dividend to the subordinate associations.

Next in order was the annual memorial service in honor of the 180 members who died during the past year. Two solos, with piano accompaniment were rendered, the service closing with the singing of "Nearer, My God, to Thee," and the bugle soundings of "taps."

That Ball Game

It had been sprinkling throughout the forenoon but who would have thought that Fate should decree that there be no base-ball game? What is an N. A. S. E. convention without a base-ball game between the engineers and exhibitors? Well, say what we might or do as we may it rained and it rained the entire day so that

HARRY A. PASTRE, NEW N. E. A. PRESIDENT

our fondest hopes and anticipations of an exciting contest were crushed to earth not to rise again for another year. But every cloud has its silver lining and so had this one. Upon being informed of the deplorable state of affairs, J. C. Griel, manager of the Auditorium, stepped in and by opening his big heart saved the day. He not only opened his big heart but also the big doors leading to the basement of the Auditorium, where to the surprise and delight of the "fans" was a veritable indoor athletic field.

Although no base-ball could be played various games and races took place which served to pass the afternoon in an enjoyable manner—especially to those who carried off the prizes.

While the afternoon's program resulted in more or less disappointment the evening brought the "big night." High-class vaudeville directly from a year's run in New York and Chicago was staged that night by the best actors and artists procurable.

Long before it was time for the curtain to rise the hall was crowded and by the time the first act was staged not another person could be crowded in. "Standing room only," "capacity house" and "nothing like it here before" were the following day's press reports.

The following took part in the program, Mr. Moser, Philadelphia Grease Co.; K. G. Merrill, M. B. Skinner &

LANE THOMPSON, VICE PRESIDENT N. E. A.

Co.; Miss Lillian Way, Richardson-Phenix Co.; W. A. Tilly, Lunkenheimer Co.; Billy Murray, Jenkins Bros.; Jack Armour, Hill Publishing Co.; Fred Hickey, Dearborn Chemical Co.; and Joe Kelly of the Perolin Co.

Friday, September 11

The last day of the convention found us early at the hall and promptly at 9:30 o'clock President Coe took the chair. At this session the auditing committee

H. D. RAYMOND, SEC'Y N. E. A.

reported the books and accounts of the secretary and treasurer correct, and $2500 for educational work and $2000 for a license-law campaign was appropriated.

On recommendation of the board of directors the contract for publishing The National Engineer for a period of 5 yr. was awarded to the Mechanical Press of Chicago.

After addresses by the various officers of the Ladies' Auxiliary a committee was appointed to take up the

J. WM. PETERSON, TREAS. N. E. A.

usual convention donation to the pension fund, which amounted to $128.47.

The next order of business was the election of officers as follows:

President, Frederick L. Ray, of Louisville, Kentucky; vice president, Walter H. Damon, of Springfield, Mass.; secretary, Fred W. Raven, of Chicago, Ill.; treasurer, Samuel B. Forse, of Pittsburgh, Penn.; trustee of The National Engineer for the term of 5 yr., Henry J. Mistele, of Milwaukee, Wis.; conductor, Louis A. Kroner, of Cleveland, Ohio; doorkeeper, J. J. McDonald, of Tacoma, Wash.

The 1915 national convention will be held in Columbus, Ohio.

Installation of officers and presentations followed by the grand ball and cotillon brought to a close one of the biggest and best conventions in the history of the National Association of Stationary Engineers.

N. E. A. Elects Officers

It was the National Exhibitors' Association that conducted affairs in the Exhibit Hall and while we were having our meetings they carried on several business sessions. It was Friday I saw the following list of newly elected officers posted on the board at the N. E. A. booth:

President, Harry A. Pastre of the Elliott Co., Pittsburgh, Pa.; vice president, Lane Thompson of the Lunkenheimer Co., Cincinnati, O.; secretary, H. D. Raymond of the A. W. Chesterton Co., Boston, Mass.; treasurer, J. Wm. Peterson of the Richardson-Phenix Co., Milwaukee, Wis.; executive committee, Thomas C. Green, Garlock Packing Co., Pittsburgh, Paul T. Payne, Dearborn Chemical Co., Chicago, Chas. Cullen, The Wm. Powell Co., Cincinnati, A. Richard Foley, Home Rubber Co., Trenton, N. J., Chas A. Wilhoft, New York Belting & Packing Co., New York City.

A Wanderer's Impressions of the Exhibit

ALTHOUGH there was a lot of work in the convention hall and things started which will do a lot of good for engineers all over the country, yet from a purely selfish motive I think I got more good out of the exhibition of power plant equipment and appliances which was held in the same building as the convention meetings.

You know, I have not been to one of the national conventions for a number of years and I got a good chance here to see the trend of the times and noted a lot of improvements along various lines, many of which I have read about but never seen, and some of which were entirely new.

Take for example pipe fittings, at the booth of the Jefferson Union Co. I saw how tees and ells have been made up into unions; these they tell me are standardized and can be secured in sizes as high as 2½-in. Then besides the straight union, with which we are all familiar, they have those which can be made up to form almost any angle. All of these have brass seat rings —the Jefferson characteristic.

In just recent years we have learned the value of proportioning the draft losses through boiler settings. I, myself, have rigged up several schemes around my plant for this work, but it has taken time and thought, to say nothing of changes and failures. Lewis M. Ellison told me what he has done along this line and showed me some gages he has devised for doing this work; one he calls a compound differential draft gage, another a multiple differential. These are ingeniously piped to various parts of a boiler setting and give the operator a lot of information about how his fires are working.

That Taylor stoker, we have been reading so much about, made by the American Engineering Co., was interesting to me; the model looks like an escalator and I guess the real thing takes the plant right up to the top floor in efficiency. During the last couple of years they have added an extension grate which keeps the unburned coal from going into the ash pit when the fire is being cleaned.

In the line of gage glasses I was interested in one called Klinger, made by the Durabla Mfg. Co. It's a flat glass set in a water column with gaskets, and V-shaped grooves on the water side to aid in making the water line visible. They make it for pressures from 300 to 500 lb. and recommend its use where vibration occurs.

Among the steam traps of the bucket type which were shown, I did not see a great deal of difference from those I have in my own plant; they are improving somewhat in detail, making them more simple and reliable. Valves and seats are made renewable or reversible and you don't have to tear your piping all

down to get at them; simply remove a cap. Then, too, some of them have air vents to do away with air binding. These improvements will save us a lot of work. Next time you get a chance examine a Boylston, or a Squires or a Strong. They are all good traps.

Then among the float traps there was that made by the V. D. Anderson Co., which has been improved by the addition of a removable strainer to catch any sediment that is likely to interfere with the valve operation. The valve and seat are renewable and easy to get at.

There is another trap made by the Armstrong Machine Works which is somewhat new to me. It has an inverted, weighted bucket over the inlet opening fastened by means of links and lever to the outlet valve. It's only a small trap, but they say its capacity is surprising and it works fine. Yes, it has a renewable valve and seat. And there were some tilting traps there, too, but aside from renewable seats and valves I saw no changes in their construction.

To those of us who are not in the manufacturing business it is not often we get a chance to see machinery in the experimental stage or just beyond it, so I was mightily interested in a Diesel engine which the Allis-Chalmers Mfg. Co. had working the day we took lunch at their factory. This engine has just been perfected for the market and they are going to build them in units of from 60 to 1000 hp. with 1, 2 or 4 cylinders. Of course you all know the Diesel engine uses crude oil.

Another exhibit that took my eye was a Milwaukee boiler with the setting partially built. It surely was a nice job and to make the exhibit complete they put in Kelly shaking grates, Reliance safety water column, Monarch boiler arch, Everlasting blowoff valve and an American safety valve.

You know it has not been a great while since engineers in the northern states have taken up artificial refrigeration and ice making and I don't think I have done as much along that line as I should, so when I saw the fittings at the booth of the Vilter Mfg. Co. I was almost like a man at sea without a compass. They soon put me right, though, and explained the uses of the various fittings and how, on account of the poisonous effect of ammonia gas even the smallest leaks are dangerous. One would hardly expect Jack Frost to be an engineer, but I guess he is.

Do you remember how we used to sit in the shop and lace belts by the hour? It took a long time to learn how and even after you did learn, it took some time to do a good job on any kind of a belt. Now the apprentice, and a lot of old engineers, too, for that matter, just take a hammer and some alligator steel lacing and do a good job, too; they get it from the Flexible Steel Lacing Co.

Improvements the Wm. Powell Co. has been making in its valves were another interesting feature of the exhibit. Valves are little things, that is most of them, and we are apt to overlook their importance until one breaks or leaks and we have to shut down the whole plant to replace it. The trend in the development of White Star valves has been towards regrinding; discs are no longer held rigidly by a nut on the end of the stem; a groove is turned in the stem near the end and a slot in the upper side of the disc fits around this so the disc is free to turn about the stem and does so at every opening or closing, giving a reseating effect. Nothing short of a broken valve stem will remove the disc from the stem while the valve is in use.

By means of special seats the valve may be packed under pressure when in the full open or closed position, and that's mighty handy sometimes. Then there are those blowoff valves, they call them the cyclone, which have a disc, a cylinder with spiral grooves on the side, giving the disc a whirling motion when opening or closing, thus cleaning the seat off to give it a good bearing.

My attention was attracted to the reinforcing which is now used on floats made by the Williams Gauge Co. in their feed water regulators and traps. As you may recall these are oblong, and made of copper in halves, each having a reinforcing ring at about its center; then the edges are turned under to hold threaded collars, one male the other female. The halves are then screwed together and soldered and over all is a plating of copper. Slight changes have been made in the valve seating on the alarm columns which make them wear longer. All these are details, of course, but they spell success or failure; success in this case.

The Wickes boiler is not new, but they had a way of showing the circulation by means of a glass model which was proof positive and I must say I have a better understanding of what circulation means.

Often we know how things work and know what the insides would look like. Even so there is just enough curiosity about me to want to see sections of apparatus, so I was pleased when the Swartwout products of the Ohio Blower Co. were opened for inspection. It doesn't look as if those curved paths in the separator and exhaust head could offer much resistance to steam, and centrifugal force does the work.

Another tendency I noticed which seems to be growing is the use of metal gaskets, such as the McKim, made by the McCord Mfg. Co.; no question about their being strong, and then, if you open a joint, there is a lot of time saved if you don't have to cut a new gasket. Force feed lubrication is another habit the McCord people are aiding. The pump they use drives the oil to each bearing in just the right amounts after it has passed a sight feed indicator. Did I tell you the oil goes through a strainer?

Efficiency has been the big talk the past few years and to aid along this line the Yarnall-Waring Co. has brought out the Lea V-notch recorder to measure the feed water. They had it working in their booth and I must say it looks simple. It not only records the amount of water but integrates and indicates it.

Safety first agitation has had its effect and the Nelson Valve Co. was one of the first in our field to aid in this direction by bringing out the Nelson-Erwood swing gate valve, which is nicely adjusted to protect a plant from an outburst of steam when a pipe breaks, or boilers from a sudden over-draft upon them.

It is surprising to me how rapidly asbestos has come into general use; you find it in nearly all articles which must be resilient and at the same time subject to heat. I noticed this particularly at the booth of H. W. Johns-Manville Co. They use it also as electrical and heat in-

sulators. Another thing I saw here was some new high temperature cement used around boiler furnaces and the like. It surely has good adhesive qualities, as I tried to break the sample joint, and they say it won't melt under 2700 deg. F.

I stopped to chat with friends in the booth of the Albany Lubricating Co. They tell me they are experimenting all the time but can't find anything better than the old Albany grease we have all used.

There is a growing tendency I find in my talks with engineers and others towards metallic packings for piston rods. Take Federal metallic packing for example, it is made up of shreds of some kind of alloy, looks like soft babbit, strands of fiber (the material depending upon what it is used for) and graphite thrown in for a lubricant. This may be pressed into any desired shape and gives little friction on the rod.

The boiler feed pump exhibited by the American Steam Pump Co. was of the packed plunger type, which seems to be growing in popularity for this purpose.

Graphite for use in boilers seems to be more and more in demand. The Joseph Dixon Crucible Co. showed me the kind they recommend for this purpose, it looks worth trying.

The Boylston high pressure Pilot reducing valve strikes me as an advance in the right direction, it is so adjusted that the reduced pressure is constant, no matter what the high pressure.

Mark cold drawn steel unions are actually pressed out of sheet steel. I hardly thought it could be done but they show up well and there's no chance for blow holes. Then with a soft brass seat the contact is perfect.

Devices for handling and filtering oil have been improved greatly in the past few years. I noticed the filters used by the Richardson-Phenix Co. are shaped much like an envelope; they were cylindrical before; more filtering surface is thus secured and less space occupied.

Analyzing boiler feed water prior to treating it chemically is a growing practice, I find. This is the method of the Dearborn Chemical Co. and there is no question about its effectiveness.

A new type of water heater has been developed by the Griscom-Russell Co., which they tell me is used widely in hotels where the demand for hot water is intermittent. It is called a storage heater and has a large water space compared to heating surface, the steam coils are U-shape tubes expanded into a removable header.

Rapidity of construction work is greatly increased these days by the use of pipe threading machines and I saw several of those made by the Toledo Pipe Threading Machine Co. in operation. They make a smooth thread and one man can operate any of them, even for the largest pipe.

We all know Jenkins Bros. valves; they don't change, not much, why should they? Just slight changes in detail, the discs are removable, of course, and are not rigidly fastened to the stem, but may turn about on it. I notice they are making an automatic stop and check valve for boiler steam mains, which is another outcome of the "safety first" movement. It bears a resemblance to other members of the family.

There seemed to be few changes in the Casey-Hedges boilers, but I have noticed a decided tendency toward the use of superheated steam, which these boilers are prepared to develop. This is evident in nearly all supplies; valves, pipe fittings, safety valves, etc. Steam turbines are no doubt largely responsible for this.

A new lubricant called Lesoyl has been developed by the Lumen Bearing Co.; it's a mixture of graphite and something else (they wouldn't tell me what), which they put in oil for all lubricating purposes.

Now when you have a valve that has lost its seat the Dexter valve reseating machine should have a place in your plant. It is not long since I used to scrap my valves, but not any more.

You never went to an exhibit yet but what you saw several different kinds of packing that were new to you; neither did I, and I was interested in looking over the line displayed by the New York Belting & Packing Co. I'll not try to describe them, it will do you good to look them up.

Cleaning scale out of a boiler was nearly a season's job, when I was learning the business; but with those Liberty tube cleaners which are driven by compressed air or steam, it is a matter of but a few hours, if boilers are properly kept. A few changes have been made in the cutting heads and some in the shape of the motors since the earlier designs, but the principle is the same.

If it happens to be a return tubular boiler you are using, the Weinland fire-tube cleaner will hammer the scale off in short order—very different from the old system with the hammer and chisel. Then when you go to put the hand-hole plates on again the Lagonda reseating machine saves a lot of work. It is driven by a motor or water pressure, while a carborundum disk grinds the seat.

There is another tube cleaner made by the Roto Co. which differs considerably in detail from those mentioned above, the steam and air motors are rotary engines taking advantage of expansion; a steel hardened sizing shield is also used to good advantage.

Somebody found that one strainer in the suction line to the condenser pumps did not always prevent interrupted service so the Liberty Manufacturing Co. makes twins which work alternately to keep trash out of the line.

The condition of belting has much to do with the efficiency of the plant and along this line the sample of treated belt shown by the Cling-Surface Co. was interesting, for it was soft, pliable and clingy after years of use.

Palmetto and Manhattan packings made by Greene, Tweed & Co., are just the same. Did I tell you packings are self-lubricating? Well, these are.

The Keystone Lubricating Co. has been experimenting with grease cups till they have something which makes grease as convenient as oil, so they say.

Special parts for boiler settings help out wonderfully when you are installing a boiler and when they stand up like steel mixture, made by McLeod & Henry Co. there is a double advantage.

The newest device displayed by the Lunkenheimer Co. was a balanced throttle valve; there were also non-return safety boiler stop valves and a full line of brass specialties. The trend of improvements with this company has been renewable discs and seats made of special

metals. For superheated steam they recommend a high pressure, all steel valve, with superheat metal seat and disc.

Just how Perolin works I was not able to find out, but all who have tried it say it does the work. It's a boiler metal treatment, that gets the scale out, and keeps it out. Did you note the Pyro Perolin treatment in Sept. 1 issue?

The Rainbow Packing family was there too, Peerless Rubber Manufacturing Co. makes the whole line. We all know it and it is as good as ever.

As new fields for the use of steam are being found and the pressure in boilers is going up continually, there is an increasing demand for regulating devices to reduce steam pressure to that demanded for various purposes. The Mason Regulator Co. makes a number of these devices, such as standard pressure reducing valves, differential reducing valves, lever style reducing valves, steam pump speed governors, steam pump pressure regulators, balanced valves, damper regulators, etc.

At the Ashton booth I found some changes in their safety valve construction. The spring has been lengthened out, giving quicker relief and a sharper working valve, the knife edge lip also helps, as it insures long service without readjustment. An outside pop regulator is also a convenience. For superheated steam the safety valve shell is of cast steel with nickel seat and disc, while the spring is exposed to atmosphere. They also showed a dead weight tester of the double area type, and they tell me the bubbling fountain is becoming more popular around power plants.

Indicators have also undergone some changes during the past few years. I took particular notice of the Trill, it has the drum stop, sure catch hook, reducing wheel of several ratios, easily replaced cord and a convenient electrical pencil operator. They also make a continuous indicator and a convenient planimeter.

In the booth of the National Tube Co. I saw what they call a self grinding valve, it has a convex seat and disc giving line contact when new but grind to a surface with use. Another new product is bent pipe for such use as refrigerating coils. The Kewanee union is just the same as it was.

The American Metal Hose Co. has a new one which is used for gasoline, the metal base is the same as that for steam, but it has a covering suitable for gasoline.

Daniels' P. P. P. packings were ever thus; these and rubber hose made up the exhibit of the Quaker City Rubber Co.

It always did seem to me like a waste to throw away the cartridge just because the fuse was blown and I am glad the Economy Fuse & M'f'g Co. has made this waste unnecessary by making renewable cartridges.

You can tie a Kantkink high pressure steam hose into 11 knots, one on top of another, still it will not kink, it has an armour of steel wire and is made by the Goodyear Tire & Rubber Co. They also make rubber and balata belting, rubber hose and packing. For superheat, asbestos fiber packing is their recommendation.

In the booth of the Penberthy Injector Co. I found a new valve, it is designed with extra thick seat allowing for regrinding, the disc is of the duplex type with automatic regrinding features and the stem may be packed when the valve is under pressure. Another new device here was an automatic cellar drainer, with pumping element, an ejector and the arrangement of check valves and strainer making it easily cleaned and reliable. The regular line of injectors was also there.

For rapid and thorough cleaning of fire tubes, the Chicago boiler tube cleaner struck me as just the thing. It's made by Seehausen, Wehrs & Co., and consists of spiral shaped knives fastened to flat springs to be pushed through inside the tubes.

Lubrication has received its share of attention in recent years and in the booth of the Standard Oil Co. I found samples of oils for all purposes. Oil is not like a cure all patent medicine any more; each machine needs a special prescription when best results are sought.

Now I have tried to give you an idea of some of the new things I saw and the impression made upon me was that the American manufacturers are alive to even the trifling needs of the power plant engineer and no sooner is a need created than a device to meet it is invented.

A complete list of the exhibitors follows:

Allis-Chalmers Mfg. Co., American Steam Gauge & Valve Mfg. Co., Julius Andrae Sons Co., American Steam Pump Co., Armstrong Machine Works, Ashton Valve Co., V. D. Anderson Co., American Engineering Co., American Metal Hose Co., Adam Cook's Sons, Albany Lubricating Co., Arrow Boiler Compound Co., Anchor Packing Co., Armour Ammonia Works, Boylston Steam Specialty Co., S. F. Bowser & Co., Bowers Rubber Co., Brodesser Mfg. Co., Builders Iron Foundry Co., Crandall Packing Co., Chase Bros. Co., Chapman Valve Mfg. Co., Central States Exhibitors Assn., Crane Co., A. W. Chesterton Co., Chain Belt Co., Cling-Surface Co., I. W. Downing, Durabla Mfg. Co., Jos. Dixon Crucible Co., Dearborn Chemical Co., Diamond Power Specialty Co., Downey Htg. & Supply Co., Edge Moor Iron Co., Elliott Co., L. M. Ellison, Economy Fuse & Mfg. Co., Engineers' Specialties Co., France Packing Co., Flexible Steel Lacing Co., Federal Metallic Packing Co., Federal Asbestos Co., S. Freeman & Sons Mfg. Co., Falls Machine Co., Ferguson Publishing Co., Gardner Grate Co., Griscom-Russell Co., Garlock Packing Co., Greene, Tweed Co., Goodyear Tire & Rubber Co., Hills-McCanna Co., Hubmark Rubber Co., Home Rubber Co., Hawkes Boiler Co., Hawk-Eye Compound Co., Illinois Malleable Iron Co., Industrial Heating and Eng. Co., Industrial Requirements Co., International Acheson Graphite Co., International Correspondence Schools, Illinois Boiler Cleaning Compound Co., H. W. Johns-Manville Co., Jenkins Brothers, Jefferson Union Co., Keystone Lubricating Co., Kent Lubricating Co., Krahn Bros. Supply Co., Liberty Mfg. Co., Lagonda Mfg. Co., Lueck Mfg. Co., Lunkenheimer Co., Lumen Bearing Co., A. Leschen Sons Rope Co., Leavitt Machine Co., Ladies' National Auxiliary, Lutz-Webster Eng. Co., McMaster-Carr Supply Co., McCord Mfg. Co., Manning, Maxwell & Moore, Manistee Iron Works Co., Mechanical Appliance Co., Milwaukee Reliance Boiler Co., Mining World, Monarch Boiler Arch Co., Milwaukee Boiler Co., McDonough Automatic Regulator Co., McLeod & Henry, W. B. McVicker Co., Mason Regulator Co., Mark Mfg. Co., N. Y. & N. J. Lubricant Co., John D. Nunan, Jr., National Brake & Electric Co., National Tube Co., Nelson Valve Co., New England Assn' Commercial Engrs., Wm. W. Nugent, N. Y. Belting & Packing Co., Otis Elevator Co., Ohio Blower Co., Wm. Powell Co., Peterson Engineering Co., Perolin Co. of America, Philadelphia Bourse, Peerless Rubber Mfg. Co., Power, Practical Engineer, Philadelphia Grease Mfg. Co., Penberthy Injector Co., Quaker City Rubber Co., Richardson-Phenix Co., John Roebling's Sons Co., Ray Mfg. Co., Roto Co., "S—C" Regulator Co., M. B. Skinner & Co., Seehausen, Wehrs & Co., Strong, Carlisle & Hammond Co., Standard Oil Co., C. E. Squires Co., Steam Appliance Co., Schaeffer & Budenberg Co., Southern Engineer, G. L. Simonds & Co., Travelers Indemnity Co., Toledo Pipe Threading Machine Co., Trill Indicator Co., U. S. Graphite Co., Universal Lubricator Co., Under Feed Stoker Co. of America, Vanda Co., Vilter Co., Valvoline Oil Co., Williams Gauge Co., Wickes Boiler Co., N. A. Olson Chemical Co., Platt Iron Wks., Schneider & Woodruff, Universal Handhole Scraper Co., Wisconsin Welding & Cutting Co., Yarnall-Waring Co., Henes Sales Corp., Western Iron Stores Co.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

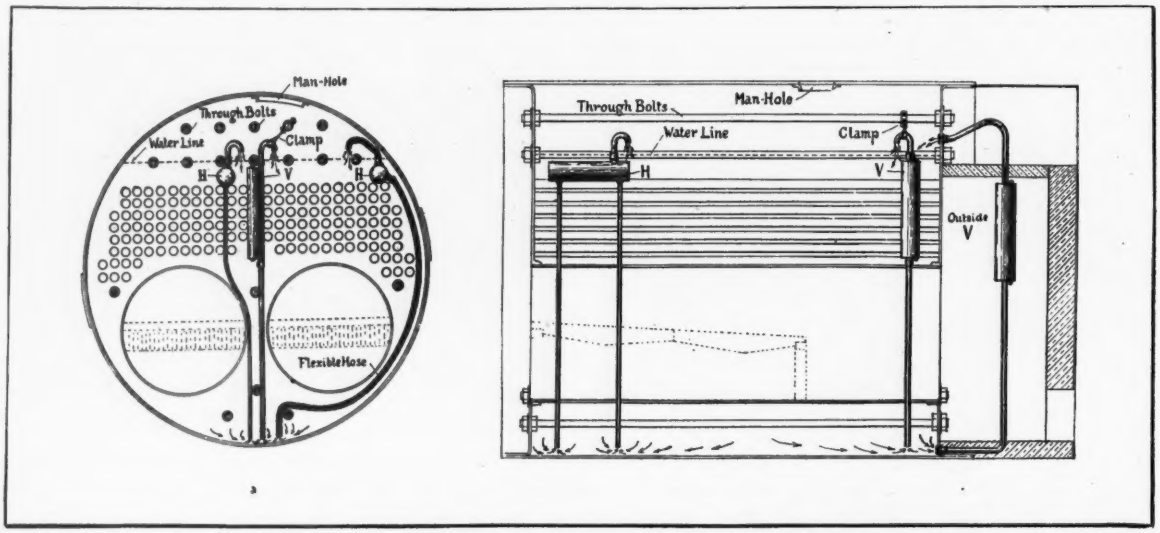
Kebec Circulator for Boiler Water

DIFFERENCE in the temperature of water, because of the poor circulation causes an uneven expansion inside the shell which results in dangerous leakage and considerable expenditures for repairs. Since water itself is a poor conductor of heat, it is natural that that which surrounds the furnace, prevents the heating of the molecules which are at a greater distance from the furnace than the water-cushion, formed by the heated stationary water. As soon as we obtain circulation this drawback is removed, and all the water parts come in connection with the heating surface.

This defective circulation is remedied by the Kebec Circulator, a recent invention made by Paul M. Klein and manufactured by John Simons Co.

The second type, the horizontal, is installed in boilers where the flues are so close together, that only a small space is left between them. Hence the body of the circulator has to be placed horizontally in the hottest part of the water in the boiler, or in other words, above the flues by way of the suction pipes which come in the small space between the flues, and also reach to the bottom of the boiler. The discharge pipe, of course, is again above the water level. When the condition of boilers is such that the suction pipes have to be bent, the circulator is equipped with flexible copper or bronze hose, which can be formed according to the shape of the boiler.

Another type of the Kebec is the outside vertical or outside horizontal circulator, applied in cases where the space in the boiler is limited or in cases of return tubular



KEBEC CIRCULATORS INSTALLED IN AN INTERNALLY FIRED BOILER

Besides protecting the shell, it increases the steaming of the boiler; thus a saving in time is effected. Because of its simple construction, it can be installed in any boiler by being inserted through the manhole. The main point to be borne in mind is that the body of the circulator must be covered with water at all times, the opening of the goose-neck must be several inches over the highest water level.

To meet all possible conditions, the circulator is made in 2 general types. One is known as the vertical type. This means that the body of the circulator is hanging vertically between the groups of tubes, being fastened with a simple clamp on a through-bolt of the boiler; the inlet pipe placed near the bottom of the boiler and the discharge pipe above the water level.

and double drum boilers. The outside circulator has its connections, one above the water level, the other on the lowest part of the boiler, the circulator drum being placed in the combustion chamber or chimney.

This type can be used to advantage for water tube boilers for maintaining a rapid circulation in the lower part of the legs and the tubes, and thus supplying the tubes above the fire with continuously circulating water.

Working on simple physical laws of vacuum and pressure in a closed chamber combined with the law of unequal water-level in a U tube, the Kebec circulator raises the cold water from the bottom, warms it up, and discharges it in the steam space, forcing the hot water to fall into the lower portion of the boiler and maintain a more equal temperature throughout the whole unit.

As soon as the fire is lighted in the boiler, and the water at the upper level reaches a temperature of about 180 deg. F., the circulator will begin to operate and continue to do so just as long as there is any variation in the temperature between the top and the bottom of the boiler.

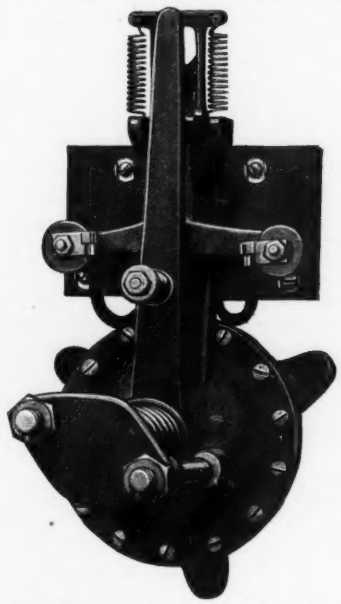
When the temperature throughout is even it does not operate, but when there is any change, the circulator will start operating again. This fact applies by feeding the boiler with cooler water, and especially in case of banking the fire.

The cold air striking the furnace is bound to cool off the lower portion of the water, causing enough difference in temperature between the lower and upper part of the boiler to induce the circulator to continue its work of equalizing the temperature throughout the unit.

The Kebec is made for a capacity of 50 cu. ft. per hr.; i.e., the normal type of the Kebec circulator will lift 50 cu. ft. cold water in an hour. This capacity can be raised to any amount as long as the construction of the boiler permits a certain size of circulator drum to enter through the manhole in the boiler. If the boiler has a larger cold water space (water space below the furnace) than one circulator can handle, it is necessary to install 2 or more circulators, according to the size of the boiler.

Control of Motors Operating on Pressure Systems

ILLUSTRATED herewith is a double-pole, diaphragm type pressure regulator designed for controlling automatically small direct-current or alternating-current motors operating on pressure systems. This regulator stops the motor when the maximum pressure desired is reached and starts it again when the pressure drops to the low value for which it is set. For direct-current motors with ratings up to 1 hp. and alternating-current motors with ratings up to 5 hp., this regulator controls the motor without an additional magnetic switch and automatically maintains pressure in the systems between any given limits.



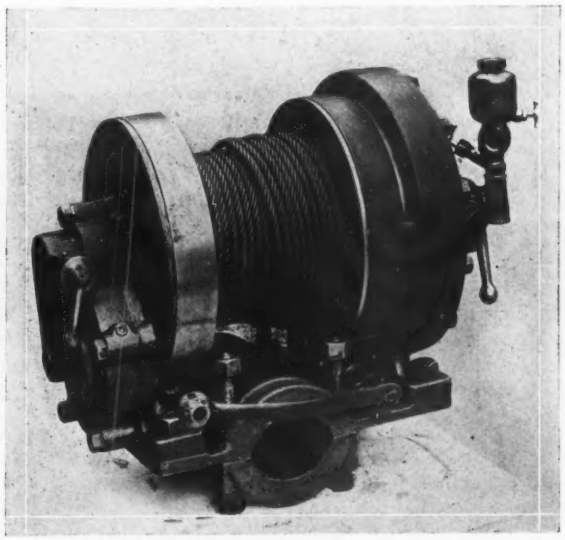
AUTOMATIC REGULATOR CONTROLLING SMALL MOTORS

The device described above is being manufactured by The Cutler-Hammer Manufacturing Co., Milwaukee, Wisconsin.

Little Tugger Hoist

A NEW type of hoist has recently been perfected and placed upon the market by the Ingersoll-Rand Co. It is intended for light lifting work, having a capacity up to half a ton and, due to its light weight, which is under 300 lb. complete, it is particularly suitable for use as a portable hoist for mines, for contract work, for manufacturing plants, for power houses and in railroad shops and ship yards.

Manufacturing and power plants find the device handy for moving light machinery, for hoisting ashes and other waste material and for loading trucks, freight cars, etc. It is a particularly desirable appliance for the foundry where heavy weights have to be moved. In ship yards, in railroad shops and in connection with construction trains, the Little Tugger hoist can be put to innumerable uses.



FRONT VIEW OF THE LITTLE TUGGER HOIST

The main base of the hoist is arranged so that it can be bolted to a timber and by means of a cap which comes with the hoist it can be clamped to a circular member, as a mine column or arm, shaft bar or pipe. The adjustment can be made quickly. The dimensions of the hoist are 21¼ by 16½ in. and the height is 20⅛ in. The drum is 6 in. in diameter with a space of 7 in. between flanges. This will accommodate a length of 700 ft. of ¼-in. rope or 450 ft. of 5/16-in. rope. The capacity is 1000 lb. at a rope speed of 85 ft. per min. and a pressure of 80 lb. It operates with either compressed air or steam.

The motor or engine is of the reversible square piston type, giving 4 impulses per revolution of the engine. There are no dead centers and it will start in any posi-

tion. The drum is mounted independent of the engine shaft and is operated through the medium of a clutch and gears. Safety is provided for by a powerful worm-operated hand brake lined with Raybestos.

Referring to the illustration showing the front view of the Little Tugger hoist, the engine is on the right hand side, the gear case is on the left and between the 2 are the brake and drum. The lever on the left controls the gears and clutch, the one on the right controls the direction of operation and the bottom lever operates the brake. The speed of hoisting is entirely at the will of the operator. When he releases the throttle, it returns automatically to central position, shutting off the power and stopping the hoist. Oftentimes the hoist will be used for haulage purposes and the release feature enables 1 man to handle this class of work. He can leave the control lever and carry the rope to the car. Hoists without this feature require 2 men, inasmuch as the rope has to be released under power.

There are no moving parts exposed except the drum, all gears and shafts being covered. This is an especially desirable feature for underground operation where the light is none too good and where there is constant danger of workmen's clothes or bodies getting caught in machinery.

New Notes

D. T. Williams has resigned his position as president and director of the D. T. Williams Valve Co.

The Gun-crete Co. of Chicago has just announced that, taking effect Sept. 1, 1914, it has purchased the interests of the Cement-Gun Construction Co. and has also taken over the construction department of the General Cement-Gun Co. In future, the combined business will be conducted under the firm name of Cement-Gun Construction Co., with offices at 914 S. Michigan Ave.

The auxiliary steam plant of the municipal lighting department, Seattle, Wash., on Lake Union, at the foot of Nelson place, is rapidly nearing completion. The 10,000-hp. turbine generator has been installed, and most of the surplus power to be generated by the auxiliary station during the winter months has been contracted for. The total cost of construction and equipment will be $300,000. This money is provided from bonds voted by the people. Adjoining the steam plant on Eastlake Ave. is a concrete station which houses the generating turbines, operated by the overflow of the Volunteer park reservoir.

The artificial ice plant on Dock St., in Easton, Pa., being erected for the Easton Merchants' Ice Co., is nearing completion, and the manufacture of ice is about to begin. Various parts of the machinery are being tested out, including the boilers, engines, etc. While the plant was built for a daily output of 50 tons, its capacity will go from 10 to 15 a day over that figure, it is expected.

Plans filed with Building Inspector George P. Roberts, of Orange, N. J., provide for a $6000 alteration to the Public Service power house in Lakeside Ave. It is planned to enlarge the building and convert the part formerly used as a generating plant into a storage house.

The Armour & Co. 3-story brick and concrete refrigerating plant which has been under construction at 219 Fifth St. north, Minneapolis, Minn., will be completed on Oct. 1, according to officials of the concern, who recently secured a building permit for the structure. The plant will be modern in every respect and will be fireproof. The cost is estimated at $45,500.

U. S. Civil Service Commission announces an examination for clerk-draftsman, on Oct. 7 and 8, 1914, to fill vacancies at $1200 a year in the offices of the Surveyors General at Boise, Idaho; Denver, Colo.; Helena, Mont.; Phoenix, Ariz.; Salt Lake City, Utah; Santa Fe, N. Mex. The following subjects will have the relative weights indicated: Report writing (test in writing in letter form, not more than 200 words in length, an orderly, concise, and grammatical statement of the essential facts included in a given statement of 400 or 500 words), 10; arithmetic and elementary mathematics (questions involving ordinary school arithmetic and elementary questions in plane geometry and mensuration), 20; copying and correcting manuscript, 10; public land surveying, 20; drawing and lettering (a specimen showing part of a land-office plat is given for reproduction to a certain scale), 40. Age 18 yr. or over on the date of the examination. Each applicant will be required to submit to the examiner on the day of the examination an unmounted photograph of himself taken within 2 yr. In applying for this examination ask for Form 1312, giving the title, Clerk-Draftsman (Male).

U. S. Civil Service Commission announces an examination for torpedo engineer, on Oct. 7 and 8, 1914, to fill 1 vacancy at $9.60 a day in the Naval Torpedo Station, Newport, R. I., and vacancies as they may occur in positions requiring similar qualifications. This position requires the services of a well-trained engineer, preferably a skilled torpedo specialist. The duties will require the performance of such work as torpedo designing, developing torpedo tests, designing torpedo attachments, simplifying torpedo mechanisms, and making the necessary calculations in connection therewith. A thorough knowledge of thermodynamics and especially of steam and gas turbine machinery, and familiarity with the principles and practice of gear design, propeller design, the use of thermostats and the testing of fuels, etc., will be necessary. A rating of at least 70 per cent in education, training, and experience is a prerequisite for consideration for this position. Age, 25 yr. or over on the date of the examination. Each applicant will be required to submit to the examiner on the day of the examination an unmounted photograph of himself taken within 2 yr.Apply for Form 1312, giving the title Torpedo Engineer (Male).

Books and Catalogs

High Power Gas Engines. By H. Dubbel. Translated from the German by F. Weinreb, New York, 1914; 197 pages, 423 illustrations and 13 folding plates. Price $5.

This book deals with the theory, principles of operation and the most important features of construction of large 4-and 2-cycle, American and European gas engines.

By the use of more or less higher mathematics, the author treats in the first 2 chapters the subjects of economical combustion, efficiency of the ideal engine, the compression, the mixture ratio, calculation of air required and calculations of cylinder dimensions. The third and fourth chapters deal with the different methods of governing and arrangement of the valve gears of 4-cycle engines. These subjects are exceptionally well treated and, aided by the use of large and clean cuts, may be readily understood by anyone. Following this, the modern 2-cycle engine is carried out in detail, particular attention being given to the methods of governing, valve gears, a comparison of 2-and 4-cycle engines and the size of charging pumps required.

The remaining chapters are devoted to a general discussion of such matters as valve gears, ignition, engine cylinders, valves and methods of cooling them, pistons and their cooling, piston-rod couplings, stuffing boxes, the design of principal engine parts such as the frames, bearings, crossheads, connecting rods, shafts and flywheels, methods of starting, types of starters and a short discussion of general gas engine piping.

Chapter XVI is devoted to indicator diagrams, a valuable feature consisting of various diagrams showing troubles often encountered in gas engine operation.

The remaining pages contain photographs and drawings of the principal engines manufactured on the European continent.

OUR MINERAL RESERVES, Bulletin No. 599. By George Otis Smith, Director United States Geological Survey, Washington, 1914; 48 pages.

This pamphlet discusses the probability of increased development of natural resources because of the European war, making America industrially more independent of foreign complications. Government publications useful to those interested in mineral supplies are mentioned. The various minerals are discussed with regard to value and supply, opportunity for export, effects of the war and the manufacture of products formerly imported.

BULLETIN 14-5, on the subject of lapwelded steel pipe, was lately issued by American Spiral Pipe Works, of New York and Chicago.

PUMPING MACHINERY is the subject of 2 illustrated bulletins Nos. 10 and 11, from National Transit Co., Oil City, Pa.

THE HILL CLUTCH CO., Cleveland, O., has just issued a new and larger general catalog, No. 11, illustrating and describing its complete line of power transmission machinery for belt and rope drive, including the Smith Type Hill friction clutches and Hill collar oiling bearings.

THE McCORD MANUFACTURING CO. has issued a new force-feed lubricator catalog, which the company believes is the most complete lubricator catalog issued. Copies will be sent to anyone who is interested.

ELECTRIC WINCHES and winding drums are illustrated as installed for various uses and their construction is described in Bulletin No. 48,901 of Sprague Electric Works of General Electric Co., 527 West 34th St., New York.

SMOOTH-ON Instruction Book No. 15, from Smooth-On Manufacturing Co., Jersey City, N. J., tells about the 8 different Smooth-On iron cements, Smooth-On concrete iron paint and the Smooth-On coated corrugated iron gaskets.

A NEW 20-PAGE PAMPHLET gives the advantages of Lagonda multiple strainers for the water intake lines of power plants and pumping stations, to remove all solid matter easily and quickly without interrupting the flow of water. These are manufactured by The Lagonda Mfg. Co., Springfield, O.

HEREWITH IS ILLUSTRATED the cover design of a new catalog on the Taylor stoker, built by American Engineering Co., of Philadelphia. This catalog con-

tains 44 pages, describing the design and operation of the stoker and its results in smokelessness, fuel saving, labor economy, etc., also illustrating Taylor stoker equipments in a number of plants.

WENTWORTH INSTITUTE has just issued its 1914--15 catalog, which includes among its courses in machine construction a 2-yr. course in foundry management and operation. The aim of this new course is to train the young man in such a manner that he will be able to advance rapidly and to take charge of preparation of machines and the design of labor-saving devices, to direct the mixing and melting of iron, steel, bronze, aluminum, etc., to assume the responsibility of core departments, or direct the testing of metals in the physical and chemical laboratories.

CATALOG 18, from The K-W Ignition Co., Cleveland, O., describes and illustrates the company's ignition apparatus.

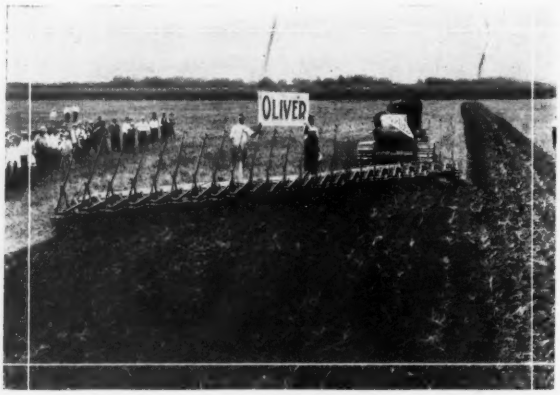
THE LATEST ISSUE of The J-M Roofing Salesman, published monthly by H. W. Johns-Manville Co., Cleveland, O., was recently received.

"NATIONAL" BULLETIN 9-C contains a full description of several special tests made on "Kewanee" unions including the following: Expansion test of "Kewanee" unions, with tabulated details; air test under water of "Kewanee" unions, to which every individual "Kewanee" union is subjected before leaving the factory, with illustrations; service test of "Kewanee" unions (illustrations of 2 which were disconnected and reconnected over 1000 times and remained tight at the end of each test).

National Tube Co., of Pittsburgh, Pa., will be pleased to forward copies to readers at their request.

Trade Notes

AT THE POWER FARMING demonstration, Aug. 17 to 22, held at Fremont, Nebr., the world's record was broken by the gasoline tractor, Caterpillar, made by the Holt Mfg. Co., Peoria, Ill. The illustration shows Caterpillar pulling 24 14-in. Oliver plows, cutting 28 ft. wide, 7½ to 8 in. deep in dry gumbo soil. The estimated



draft is 21,600 lb. Working weight of the engine is 27,000 lb., 80 per cent of weight in drawbar pull—one record. Biggest plow ever pulled by 1 engine—second record. Estimated drawbar horsepower, 115.8—third world's record for traction engine.

AN ITEM of considerable interest just at this stage of commercial and general unrest is a report of the business transacted by the Northern Equipment Co., of Erie, Pa., during the past year. In the face of strong competition made especially keen by unsettled business conditions the sales of this company were practically doubled within the year. Parallel with the growth of the sales there has naturally been a corresponding demand for sales representation of the products of the company recently resulting in the addition of the following new agencies: Scholey and Company, Ltd., 151 Queen Victoria St., London, Eng.; Thermal Efficiency Co., 716 Finance Bldg., Kansas City, Mo. The first named will represent the Northern Equipment Co. in the British Empire and the last named in Missouri, Kansas and Oklahoma. To care properly for increasing sales, the company has purchased the shops formerly occupied by the Olds Pump Works of Erie, Pa.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

SEMI-MONTHLY

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH.

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.

In Canada, subscription price, $1.75 a year.

Foreign Countries, subscription price, $2.50 a year.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 So. Dearborn St., Chicago, Ill.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES

Display

Full page, one year, each insertion, $60.00.
Half page, one year, each insertion, $35.00.
Quarter page, one year, each insertion, $20.00.
Eighth page, one year, each insertion, $12.00.
Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stipped plates used, but no heavy, black and white plates.

Invoices are rendered monthly and subject to 2 per cent discount within 10 days.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500.

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Wanted

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

WANTED—Resident subscription agents in all cities of 50,000 population, and over. Many of the largest cities still open. An excellent chance for hustlers to turn their spare time into dollars. Practical Engineer, 537 S. Dearborn street, Chicago, Ill.

MR. ENGINEER—If you are tired of the daily rut of your job, and are ambitious to make a way for yourself in the selling end of the engineering line, we have something unusual to offer you. Become a sales engineer and earn three to six times as much as your present salary. You can do it without any risk whatsoever, but you must possess certain qualifications. Write us and we will tell you if you are eligible. We manufacture boiler appliances of the highest merit and standing, selling as high as $400 per boiler, and yielding in commissions as high as $100 per boiler. One sale may mean more than your week's salary. Write us. Box 349, Practical Engineer. tf.

FREE ENGINEERING BOOKS and power plant tools and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address, Practical Engineer, Subscription Department, Chicago, Ill. tf.

WANTED—Anyone who has trouble with foaming or priming boilers and leaky tubes to know of our sure remedy for these evils. Write for details to Olson Automatic Boiler Circulator Co., 217 Chamber of Commerce Bldg., Chicago, Ill. 10-1-1

WANTED—A few hustlers to take orders for Zinco Soot Destroyer. Quick Sale. No competition. Good proposition. New York Supply Exchange, Ford Bldg., Detroit, Mich. tf.

HIGH-GRADE ENGINEERING company, fine office, strong force, will handle factory sales account. A. F. S. Co., 656 Leader Bldg., Cleveland, Ohio. 10-1-2

WANTED—Competent and experienced salesmen for Corliss engines, water-tube and tubular boilers. Murray Iron Works Company, Burlington, Iowa. 9-15-2

Help Wanted

MR. ENGINEER—Do you want to add $5.00 or $10.00 a month to your pay with very little effort on your part and without interfering with your present employment? Others are doing it—so can you. Write for proposition and terms today. Box 369, Practical Engineer. tf.

ESTABLISHED COMMISSION AGENTS wanted in the following districts: Philadelphia, Baltimore, Atlanta, Cleveland, Milwaukee and Omaha. See our advertisement, page ——. Betson Plastic Fire Brick Co., Rome, N. Y. 10-1-1

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

ENGINEER—One of the largest New York office buildings needs the services of a chief engineer. In applying state age, experience and nationality. Address Box 370, Practical Engineer. 10-1-1

WANTED—Competent Sales Engineer to sell well-known line on commission basis. H. T. Maurel, 604 W. 115th St., New York, N. Y. 10-1-3

For Sale

AN ENGINE BARGAIN—1 Hewes & Phillips Cross Compound Horizontal Engine, 16⅛-in. and 28-in. by 42-in.; 450-hp., at 100 lbs. pressure, 12-ft. by 40-in. flywheel, floor space, 18 ft. by 25 ft. 1 Watts-Campbell, single-cylinder, horizontal R. H. Corliss engine, 18-in. by 42-in., 150-hp. at 100 lbs. pressure, 12 ft. by 30 in. flywheel, floor space 10 ft. by 24 ft. 1 Watts-Campbell, single-cylinder, horizontal R. H. Corliss engine, 16 in. by 42 in., 125-hp. at 100 lbs. pressure, 12 ft. by 30-in. flywheel, floor space 10 ft. by 24 ft. 1 Wm. Wright, single-cylinder, horizontal, old type Corliss engine, 16⅛ in. by 30 in., 75-hp. at 85 lbs. pressure, 12-ft. by 32½-in. flywheel, floor space 18 ft. 10 in. by 6 ft. 8 in., side crank, 4-valve releasing gear. All the above in first-class condition. Address Box 360, Practical Engineer. 8-1-5

MOTORS FOR SALE—The following new, special type, guaranteed motors: 4—¼ h.p., 110-60 a.c., 1750 r.p.m.; 2—½ hp., 110-60 a.c., 1750 r.p.m.; 2—1 h.p., 220-60 a.c., 1750 r.p.m.; 3—2 h.p., 220-60 a.c., 1750 r.p.m.; 5—1/6 h.p., 110 volt d.c., 1750 r.p.m.; 6—¼ h.p., 110 volt d.c., 1750 r.p.m.; 3—2 h.p., 220 volt d.c., 1750 r.p.m.; 4—5 h.p., 220 volt d.c., 1750 r.p.m.; 1—7½ h.p., 220 volt d.c., 1750 r.p.m.; 2—10 h.p., 220 volt d.c., 1750 r.p.m. Also a number of small generators, 5 lights and larger. Write and tell us what you need, mentioning this ad. Fidelity Electric Company, Lancaster, Pa., U. S. A. 10-1-2

GROBET SWISS FILES are the standard of excellence in files, and have been for over 100 years. We send post paid, as an introducer, 48 files especially adapted for tool makers and machinists on receipt of $5.00. This is a chance to get a set of files you'll appreciate and we'll get future orders. Montgomery & Co., 101 Fulton St., New York, N. Y. 10-1-1

ENGINES—Two 15 by 12 Harrisburg Fleming, side crank engines, $300 each; one 17 by 24 Erie City, 4-valve engine, $700; two 18 by 30 Reynolds Corliss engines, $700 each; one 28 by 48 Hamilton Corliss engine, $1200; one 8 by 12 Buckeye engine, $125; one 8 by 8 New York Safety engine, $100. Duzets & Son, 50 Church St., New York, N. Y. tf.

FOR SALE—20-inch New Haven Screw-cutting engine lathe, $250.00; six Lincoln millers, each $50; six 18-inch drill presses on one base, price, $200.00. J. L. Lucas & Son, 3 Fox St., Bridgeport, Conn. 9-15-2

FOR SALE—At a Bargain. New 5 by 6, 4-cylinder, governor-controlled engine, fully equipped with carburetor magneto. Will sell for much less than cost. Fred Hanson, 570 Prior Ave., St. Paul, Minn. tf.

Patents and Patent Attorneys

FIND OUT FOR YOURSELF what to invent, and how to procure and sell a patent. My book, "Inventor's Educator," covers the matter from A to Z. 140 pages, elegantly bound. Has 600 mechanical movements and 50 perpetual motions. Price, 50 cents, coin or postage. F. G. Dieterich, 605 Ouray Bldg., Washington, D. C. 9-1-4

PATENT YOUR INVENTION. Send sketch for free expert search and report as to patentability. Books on inventions and patents, and books of references from congressmen, manufacturers, bankers and inventors sent free. John S. Duffie & Co., 612 F St., N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 24 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Educational and Instruction

ENGINEERS' POCKET MANUAL, 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in NEW subscription (not your own) to Practical Engineer. Gilt edges; bound in leather.

Miscellaneous

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

We wonder if the engineer in Oskaloosa, Iowa, or Kokomo, Ind., appreciates the labor and expense involved in illustrating the advertisements in Practical Engineer. Probably not . . . ! The average engineer has enough to think of without bothering his brain about subjects outside of his daily work. There is, nevertheless, a great deal of human interest in the subject of advertising illustrations.

The man with the pencil or camera goes everywhere to obtain the illustrations which are reproduced in the advertisements in technical papers. Groping his way in dark underground tunnels, descending into the depths of the earth, climbing to the dizzy tops of unfinished buildings, perching himself on ladders among revolving wheels and cogs, obtaining narrow footholds above giant machines,—he often risks life and limb to obtain an out-of-the-ordinary photograph.

A few weeks ago, an issue of Practical Engineer contained an advertisement of the American Injector Co., showing the U. S. Battleship "Vermont" riding at the top of a huge wave in a mountainous sea. Draw on your imagination, if you can, for an idea of the conditions under which this photograph was obtained. Certain we can be, that its taking was not mere child's play.

Sometimes, the cost of a single illustration for an advertisement in an American periodical is very high. It was only a few months ago when even the advertising fraternity was pleasantly startled by a Chicago Mail Order House bringing out a series of advertisements illustrated by such famed artists as James Montgomery Flagg, Chas. Dana Gibson, Howard Chandler Christy, Orson Lowell, etc. There is reason for this astonishment when it is realized that these artists obtain from $500.00 upward for a single drawing.

Many of the familiar faces we see in advertisements are the result of much effort on the part of the photographer. The face that smiles, frowns or looks wise at us from the printed page was not selected offhand. More likely it was chosen after the photographer had scanned the faces of many models. The photographer and advertising man wanted a face that would individualize the product. "The Sweetheart of the Corn" of Kellogg's Corn Flakes, "The Crane Man" of the Crane Co., the "Have you a Little Fairy In Your Home Girl?" of Fairy Soap, and "The Engineer" of the D. T. Williams Co., are all illustrations of this type.

Why is this done? Why do advertisers pay out this money? Because pictures are easy to read. They make clearer the story of the advertisement. An illustration showing the construction of a machine conveys more about that particular machine than would hundreds of words. Illustrations rest the eye and brain by breaking the monotony of type.

The effort of the advertising man ever is to make easier the reading and understanding of advertisements. You can be of help to him at times. You know that which impresses you most favorably. Write to him your suggestions about his advertising in Practical Engineer. He will thank you for it.